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ABSTRACT

This report describes the program and examines the advantages and disadvantages of the semiannual admissions system used by the University of Tennessee College of Medicine (UTCM). It also considers effects of an accelerated program which together with the use of a semiannual admissions system permit more efficient use of facilities and the instruction of almost twice as many students in a given amount of time than would normally be the case. For the study, data on UTCM were compared with data on all US medical schools, but particularly with the Louisiana State University School of Medicine (LSU), which is located in the same region and has similar applicants, students, curricula and financing levels. Items compared were: ratio of undergraduate medical students to full-time faculty; expenditures per student in physiology; base salaries of basic science faculty; types of teaching and training grants received; a percentage of full-time faculty receiving 50% or more of their salaries from federal sources; persistence rate; MCAT science scores; and ratio of net square feet occupied to full-time faculty in various departments. Data were obtained through interviews, records searches, and visits to hospitals where UTCM graduates were serving as interns and residents. One of the conclusions was that if relative costs of producing MDs at UTCM and LSU are comparable for all US medical schools, semiannual admissions at all schools would produce 20 to 30% more doctors with no increase in expenditures. (JS)

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A STUDY OF THE SEMIANNUAL ADMISSIONS SYSTEM AT THE UNIVERSITY OF TENNESSEE COLLEGE OF MEDICINE

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CONTENTS

I INTRODUCTION AND DISCUSSION OF MEDICAL EDUCATION 1

Curriculum Change 2
Acceleration 4
Scheduling of Admissions 5
Other Changes with Potential Effects on Enrollment Capacity 7

II SUMMARY 9

Methodology 11
Assessment of the Advantages and Disadvantages of the Dual Admissions System 11

III DESCRIPTION OF THE TENNESSEE PROGRAM 17

Introduction 17
Comparison of UTCM with Other U.S. Medical Schools 19

IV ADVANTAGES AND DISADVANTAGES OF THE SEMIANNUAL ADMISSIONS SYSTEM 29

Methodology 29
Background for the Evaluation 31
Applicants 33
Students 34
Graduates 39
Faculty 45
Organization, Management, and College Operations 49

V COSTS PER M.D. GRADUATE 53

Problem of Research Expenditures 54
Problem of the Division of the Medical Program into Basic and Clinical Sciences 54
Problem of Additional Lifetime Earnings 57
Estimation of Costs 57
Cost of First Half of Medical Training 61

CONTENTS

VI CONCLUSIONS AND RECOMMENDATIONS 71

General 71

Suggestions and Recommendations Regarding the Establishment of Multiple Admissions Systems in Medical Schools 74

REFERENCES 77

APPENDICES

A DUAL ADMISSIONS SYSTEMS FOR MEDICAL COLLEGES 79

B CONCEPTUAL FRAMEWORK FOR COST ANALYSIS 87

ILLUSTRATIONS

1 Approximate Curriculum Schedules 18

TABLES

1 Student/Faculty Ratios 20

2 Expenditures per Student in Three Basic Science Departments 21

3 Annual Faculty Salaries 22

4 Ratio of Faculty Salaries at All U.S. Medical Schools to Those at UTCM, 1964 and 1969 23

5 Number of Teaching and Training Grants for Certain Departments 24

6 Percentage of Full Time Faculty Who Received 50 Percent or More of Their Salaried Income from Federal Research or Training Grants (1968/69) 24

7 Percentage of Full Time Faculty Receiving at Least 50 Percent of Their Salaried Income from Federal Research or Training Grants, by Basic Science Departments (1968/69) . . 25

8 Net Square Footage per Full Time Faculty 26

9 Course Equivalents and Hours 27

10 Aggregate Annual Average Cost per Undergraduate M.D. Student at LSU and UTCM 1965/66 to 1968/69 59

11 Cost per Student During First Half of Undergraduate M.D. Program 62

12 Salary Differentials and Ratios by Rank for 1965/66 and 1966/67 64

13 Ratios of Cost per Student 67

I INTRODUCTION AND DISCUSSION OF MEDICAL EDUCATION

There are a variety of methods, either in use or proposed, by which the output of physicians might be increased to meet current and projected medical care needs. Both increased physician outputs and more effective and efficient employment of physicians and allied medical personnel will assist in meeting care requirements. The current study is concerned only with increases in the number of medical students and graduates and in particular with a system of semiannual admissions operated by the University of Tennessee College of Medicine. The analysis and determination of advantages and disadvantages of that system were the primary purposes of this study and of the report here presented.

Most medical schools in the United States schedule attendance for four academic years of about nine months duration each, for a total of 36 months. Summers are usually not a part of the formal schedule, so that calendar time from entry in medical schools to the degree is about 45 months, with internship following very shortly after graduation. The number of class hours is about 5,000 for most institutions. The first two academic years are primarily devoted to basic sciences, the last two to clinical instruction. Most entrants to medical schools have bachelor's degrees before they enter and have completed a prescribed pre-medical course, although many schools accept candidates without bachelor's degrees. Graduate medical education (internships, residencies, research) varies in length, depending on specialty choice and other factors, but may occupy four or more years beyond the degree before the physician is fully qualified for independent practice in his chosen field. Continuing education beyond that point, carried out by a variety of methods, is also needed to keep physicians current with respect to rapidly changing medical knowledge and techniques. Medical education is long, arduous, and costly, and methods of reducing all of these factors without adversely affecting the quality of medical care have been widely sought by medical educators.

A number of factors may be varied in the process of making changes to develop more efficiency in medical education. These include:

- The number of students admitted
- The number of students dropping out
- The number of students dropping back

- Faculty size and student faculty ratios
- Articulation of undergraduate education before the bachelor's degree and medical education
- Laboratory, classroom, and clinical facilities
- Technological instructional devices
- Curriculum (basic and clinical sciences, electives)
- Scheduling, including lengths of break periods
- Admissions scheduling (frequency of admissions)
- Availability of continuing education facilities

Most of these factors are interrelated, so that if changes are made in one others must also be altered. Planning and implementation are, therefore, complex and time consuming.

Curriculum Change

Curriculum change is occurring in several directions. A general trend is toward a reduction in basic science instruction in medical schools and a reorientation of that which remains. A number of medical schools have already made curriculum changes and many others have them planned or under consideration. Some laboratory courses are now optional in some schools. Basic science instruction requires extensive and often costly laboratory facilities and substantial commitments of faculty and technician time. Both cost and time required for medical education may be reduced, therefore, if basic science courses are streamlined or reoriented.

Some part of the basic science instruction given in most medical schools often duplicates premedical courses that some students have already had. It may, however, be difficult to eliminate medical school courses on this basis because the premedical background of entrants to any given school differs depending on the undergraduate institutions from which they came. This is, of course, one of the primary reasons for the scheduling of basic science instruction in medical schools. Advanced placement for those who have met the basic science requirements as undergraduates is used in some cases. The problem is alleviated in part by requiring certain courses as a prerequisite to admission. Some have, however, expressed reservations about extensive premedical requirements, since they may make it impossible for the student to take courses in behavioral and social sciences and the humanities that are felt to be desirable as a background for medical practice.

In some cases the recommendation has been that the amount of instruction given in certain basic sciences such as anatomy be reduced because the student does not need as many hours as are now given as a basis for his further education or his practice as a physician. This is the subject of controversy that will not be resolved for some time in many schools.

Another major trend in basic science instruction is the crossing of disciplinary lines to organize courses centered on organ systems. This may imply changes in instructional and laboratory facilities, instructional methods, the preparation of teachers and, in its initial stages at least, it may be more costly than conventional instruction for those reasons.

Basic science departments are often responsible for the graduate instruction of nonmedical as well as medical students. These include nursing, pharmacy, and dental students and graduate students in the separate disciplines. It is difficult to assess the effects of these arrangements on the efficiency of educating medical students. Courses may be less specifically tailored to medical needs, leading to wastage of medical instruction time. On the other hand the larger number of students may make for more efficient full time use of laboratory facilities and staff.

Clinical curricula are also undergoing change, primarily in the direction of providing more electives, so that students can adjust their programs to their particular needs and future plans. There is little reason to believe that these changes will affect the number of physicians graduated, but they may affect the kinds of practice in which some physicians will engage and therefore the effectiveness of the delivery of medical care.

It has been suggested that the fourth academic year might be eliminated altogether in favor of entry into internship after the third year, or that internship be eliminated altogether with immediate entry into residency after graduation. Physician output per unit of time would, presumably, be altered by either scheme, although it is not clear that all students entering such programs would in fact start full independent practice a year earlier than would otherwise have been the case.

An issue related to that of curriculum change is that of the primary purpose of medical school instruction. All medical schools produce both practitioners and medical researchers and teachers. Some graduates combine all of these activities either simultaneously or at different times of their careers. Certain schools, however, tend to put more emphasis on

one kind of training than another, and they attract students with particular orientations. Those schools emphasizing the education of practitioners may not feel that it is necessary to include very much research training in their curricula, although almost all medical educators would agree that practitioners need to understand how research is conducted in order to evaluate evidence relating to new techniques or drugs that they will receive from various sources. The amount of research training and of student research thought to be appropriate at a given institution has a critical bearing on time and monetary costs of medical instruction in that institution.

Acceleration

A number of medical schools have adopted accelerated programs as a means of increasing their output of medical graduates. The extent to which the general adoption of accelerated programs would increase the total number of physicians starting practice in a given period of time is difficult to assess. Consideration must be given to the size of the pool of qualified applicants in any given year, the effect of earlier graduation on the rate of movement of degree holders through internship and residency, dropout and dropback rates, and even individual maturation factors in trying to determine the effect of acceleration on the number of practicing physicians available in a particular time period. If sufficient qualified applicants are available, however, it appears probable that the output of degree holders per unit time would be substantially greater than would be the case in the more extended programs.

Acceleration was undertaken on a large scale during World War II because of the acute emergency need for physicians. Degrees were granted in 33 to 36 months after entry in medical school. Some graduates of these wartime accelerated programs felt that the pace was far too fast and would not like to repeat the experience. Faculties could not be increased in size, so they were put under greater stress. Some feel that it took them just as long a time to achieve full practicing competence as would have been the case if they had attended school on a normal schedule, and that the fast pace made them miss a good deal that they later had to acquire in some other way.

Acceleration places stress on both faculty and students, and does require increases in faculty and in some facilities. If it leads to higher dropout or dropback rates there may be little net gain in time. Advantages are that faculty members may be able to increase their incomes by teaching for an additional period of time each year (at the probable

cost of loss of research time) and that students can begin their productive earning period sooner than would otherwise be the case.

Acceleration takes two basic forms. The first of these is the World War II type in which the existing curriculum was simply compressed by using what had been summer and other break periods for instruction and making minimal or no changes in curriculum. Other accelerated programs have made more extensive curriculum modification, but often it is simply the substitution of class hours in one subject for those in another, so that the total number of hours is not reduced but simply compressed into a shorter period of elapsed time.

The other basic acceleration format involves undergraduate education toward the bachelor's degree as well as medical education and requires that an articulated cooperative program be developed taking into account curriculum and scheduling at both levels. Boston University, as an example, has developed a program permitting selected students to receive both Bachelor's and Medical degrees in a total calendar time of six years from high school graduation. The first two years and three summers are spent in the College of Liberal Arts. Included are premedical science courses designed especially for this program. Three 12-week summer sessions within the liberal arts part of the program make possible the acceleration. Medical studies begin in the third year. The number of hours in the medical school for accelerated students is exactly the same as for students on the normal schedule. There is a seven year option for those who wish to spend an extra year in liberal arts college. Students must also complete a minor in a field other than natural science. This last tends to answer one of the objections raised to acceleration--that it does not permit a fully-rounded educational background. The Boston University program is only one example of such programs articulating Bachelor's and Medical degree studies to bring about graduation in less than the normal amount of time.

Curriculum alterations may be made simultaneously with acceleration, but usually, as in the case of Boston University and others, the total amount of hours in medical subjects (about 5,000) has remained nearly constant.

Scheduling of Admissions

Another major technique for increasing the output of physicians is multiple scheduling of admissions. At present the only medical college in the United States employing this method is The University of Tennessee College of Medicine. The College was on a schedule calling for the

admission of a new class every three months (four classes a year) from 1930 until 1963, when a change to two admissions a year was made. The purpose of multiple scheduling and year round operations has been to make maximum use of facilities and faculty, and to admit and provide medical education for as large a number of students as possible to meet State needs for medical care. The Tennessee system will be described in detail in the next section. It should be noted, however, that it employs both multiple admissions and acceleration to achieve the aim of increased output.

The George Washington University School of Medicine is in the process of developing double scheduling plans that will be put into operation in 1972. It differs from the Tennessee system in a number of ways, but it will serve as a point of departure for some general comments on multiple admissions. The objective is increased physician output. Basic science instruction has generally been the limiting factor in increasing enrollment, because during periods of use laboratories cannot accommodate larger numbers of students. On the other hand, laboratories are often used very little or not at all in the periods between courses given to medical students, and may be essentially unoccupied for half the year or more. The primary advantage of double scheduling is the potential for use of basic science classrooms and laboratories on a more continuing basis so as to permit doubling of enrollment. So long as there are adequate hospital facilities available, the accommodation of larger numbers of students in clinical instruction is much less difficult.

In the past, George Washington has functioned on a conventional schedule of two 16-week terms (Fall and Spring). A 16-week summer term will be added. Term I courses will be taught in summer and fall, Term 2 in fall and spring, and Term 3 in spring and summer. Clerkships will operate continuously as they have in the past, but will be expanded to accommodate more students. Entering classes will be in two divisions, one entering in June and a slightly smaller one entering in October. Each will progress through the course of study independently. First Division students may accelerate to varying degrees permitting graduation in 37 to 43 months of elapsed time. Second Division students will have normal summer vacations, and may decelerate if required, so that elapsed time will range from 49 to 61 months. Curriculum changes including an increase in electives are also being instituted as a part of the new plan. Faculty will be increased so that teaching loads can remain at their present levels.

The plan will accommodate 50% more students than are now admitted. Class size will be reduced. Costs are also expected to be reduced through more efficient use of basic science laboratory space and equipment.

Multiple scheduling has a number of potential advantages as a means of increasing physician output, particularly if it is used in conjunction with acceleration. It can provide for more continuous use of facilities, and for their use by larger numbers of students in a given unit of time. New faculty must be recruited, although doubling may not be necessary if existing faculty are willing and able to increase their teaching loads with some additional compensation.

Other Changes with Potential Effects on Enrollment Capacity

Technological innovation may be used (such as computer assisted instruction, closed circuit television, or dial access retrieval of core curriculum on video or audio tape) to improve instruction and to reduce class time or faculty loads, but so far it does not appear to have affected the total number of hours in medical school or to have had a substantial impact on physician output. Rapid changes in medical knowledge tend to make some of what is taught in the schools obsolete. Education after graduation must be used to update physicians. The use of such continuing education may eventually reduce the amount of time to be spent in formal training as an undergraduate in medical school, but up to now there is no evidence that any substantial change in that direction has occurred.

It is clear that there is great concern among medical educators about problems of increasing enrollment without adversely affecting quality of medical education or its product. In some instances curriculum change and acceleration have been adopted by a number of institutions as a means of meeting the objective of improving medical education and increasing enrollments as well. The University of Tennessee College of Medicine is the only institution in this country that has had substantial experience with multiple scheduling, and the remaining part of this report will be concerned with the advantages and disadvantages of that system in operation. The primary study objective is to provide information to other medical schools that may be considering multiple admissions as a means of increasing physician output.

II SUMMARY

Among the methods of increasing medical school enrollment and output per unit of time (including curriculum reduction, acceleration, and admissions changes) the use of an admissions system permitting the entry of two classes a year is in operation at only one U.S. institution--UTCM (The University of Tennessee College of Medicine). The College also has an accelerated schedule. The primary purpose of both acceleration and dual admissions is to permit more efficient use of facilities and the instruction of almost twice as many students in a given amount of time than would otherwise be the case. The system accommodates about 200 entering students per year. Neither laboratory nor classroom facilities would be adequate for this number if they did not enter in two increments of approximately 100 students each in September and March. The study here reported is focused on the dual admissions system, but also considers the effects of acceleration, since they cannot be separated in practice.

At UTCM medical degrees are normally obtained in about 39 months from entry, with graduation in December or June. Facilities are used on a year around basis. There are six terms of 22 weeks each, with only one substantial break period, three months between the third and fourth terms. The curriculum is given in about 5,000 scheduled hours, which is average for U.S. medical schools, and the content is similar to that of most other schools as well. As with most schools, the first half of the instruction is primarily in basic sciences, and the last half is in clinical subjects. Basic science instruction is given by a separate College of Basic Medical Sciences with its own Dean. It also provides basic science instruction for graduate science, dental, nursing, and pharmacy students. This organizational arrangement has been criticized on the grounds that it may not provide instruction for medical students that is tailored specifically to their needs.

For the purposes of the study it was decided to compare UTCM, using certain indicators, with other institutions and particularly with LSU (The Louisiana State University School of Medicine). LSU is located in the same region of the United States, has applicants and students from similar sources and of comparable quality and has similar curricula and levels of financing. LSU data served primarily as a rough research control in the cost analysis, but comparisons are relevant in other areas as well. Comparisons were also made with data on all U.S. Medical Schools and with a

sample of 26 drawn for another purpose, but on which relevant data were obtainable.

The following comparisons were made:

- The ratio of undergraduate medical students to full time faculty is 2.2 at UTCM. This is a little lower than the LSU ratio of 2.4 and substantially higher than the 1.6 figure for all U.S. medical schools.

- Expenditures per student in physiology were about 30 percent higher on the average for the 26-school sample than at UTCM, nearly twice as high in biochemistry, and more than twice as high in pathology. The major difference is in sponsored programs.

- Base faculty salaries in basic sciences at UTCM are nearly the same as the average for all U.S. medical schools. In clinical science, the U.S. average is 25 to 30 percent higher than at UTCM.

- With respect to teaching and training grants, UTCM receives more than the median for the 26-school sample in physiology and pathology, and substantially less in biochemistry, medicine, surgery, and pediatrics.

- At UTCM the percentage of full time faculty receiving 50 percent or more of their salaries from federal research or training grants is 20.2 percent for all departments. This compares with a figure of 24.1 percent for LSU and 27.8 percent for all U.S. medical schools. The major difference is in the basic science departments where the overall percentage for all departments is less than half that for LSU and for all U.S. schools.

- About 80 percent of the entering class at UTCM had completed four or more years of college, as compared with 70 percent at LSU and 89 percent for all medical schools.

- The average MCAT (Medical College Aptitude Test) science scores for all accepted U.S. medical school applicants was 550, while at UTCM it was 520.

- In the Department of Physiology, the ratio of net square feet occupied to full time faculty is about twice as high at UTCM than the average for the 26-school sample in physiology. It is more than three times as high in biochemistry and about 40 percent higher in pathology.

Methodology

In order to obtain the data and other information used in the study, administrators, faculty members, students, and graduates of UTCM were interviewed. Searches of relevant financial, alumni, and other records were made. In addition, interviews were held with faculty and administrators of LSU and a number of other medical schools, and records searches were conducted at LSU. A number of hospitals were visited to interview UTCM graduates serving as interns and residents and to obtain estimates of their proficiency from hospital supervisors. Finally, officials at AAMC (Association of American Medical Colleges) and NIH (National Institutes of Health) were interviewed to obtain their insights on various aspects of medical education.

Assessment of the Advantages and Disadvantages of the Dual Admissions System

Findings and conclusions with respect to various aspects of the UTCM system are as follows:

- The entering student body at UTCM, most of whom are Tennessee residents, is slightly below average for Southern schools (according to MCAT scores), about the same as that for Southern State schools, and considerably below the average for all U.S. schools. There is no clear relationship of this factor to biannual admissions. If the system functions satisfactorily for the general level of UTCM students it might be expected to be usable in other institutions with a below average level of student input, but might work less well in institutions with students more interested in research, and the like.

- The two entering classes are thought to be of different quality, with the September class judged to be somewhat superior to the March class. This is not seen as a serious deficiency, although it may require some adjustment in instruction for the two classes. In any case, it could be altered without affecting the basic admissions policy.

- Large classes permit the entry of more out of state applicants, which contributes to the breadth of experience and background of the student body.

- There is no difficulty in filling the March class quota, since undergraduate acceleration is quite common.

- About seven percent of the total hours at UTCM are for electives, which are available only in the last term. This is a lower proportion than in many schools, but more than in some others. The relationship to dual admissions or accelerations is not clear, but with smaller classes and a less concentrated schedule, more elective time might be available.

- Student research is encouraged, but there is no exemption from any classroom or clinical work to participate. Both schedule and class size tend to limit time for student research.

- The scheduling of only one three-month break period reduces the opportunity for students to work to obtain needed money, as is common at many other medical schools, but UTCM students' earlier graduation permits them to start earning money earlier as well.

- The 2.2 ratio of medical students to full time faculty at UTCM, which is in the third quartile for all medical schools, limits the amount of student-faculty contact, but the division of each entering class into two smaller groups does permit contact and counseling that might not take place with a single larger class. Both students and faculty felt that the amount of individual contact was generally adequate. Faculty members recognize the responsibility, and those who teach classes twice a year do seem to find the increased time made available by the semiannual system with its smaller classes to be highly desirable.

- The attrition rate is 11 percent, which is more than the average of 6.7 percent for medical schools in the United States. There is no evidence, however, that dual admissions or acceleration bring about increased attrition.

- The rate of dropping back, or irregularity, is 30 percent, which is the highest in the United States. A failing student has no alternative but to join another class, since there is no possibility of summer make-up time on the accelerated schedule. On the other hand, a failing student does not have to drop back a whole year, but only one six-month term, so that some who might drop out altogether if it were necessary to repeat an entire year can be salvaged.

- Student performance on Part I of National Board examinations covering basic medical sciences were in the last quartile (according to data from UTCM), during the period when passing the test was a prerequisite to entrance to clinical training. This is probably

attributable more to the quality of the student input than to any effect of either biannual admissions or acceleration.

- UTCM students are available for patient care in teaching hospitals on a year around basis.

- UTCM students tend to be oriented toward practice rather than research or teaching. They generally do not recognize a strong need for student research opportunities, and do not feel that the lack of such opportunities in the program is a serious deficiency.

- Students would like more individual choice in the form of electives in accordance with the trend toward greater individualization of instruction in higher education in general.

- Most students would react unfavorably to the addition of another six month term to accommodate more electives. This would be particularly difficult for March entrants, who might have to wait an entire year after graduation to participate in the intern matching program. Students feel that any delay would be excessively costly in time and money, and they favor acceleration, which most of them do not find unduly stressful.

- A commonly used measure of the quality of training given medical students is the character of the internships that they receive. Good internships are generally thought to be those in hospitals (a) associated with medical schools, (b) with a small proportion of graduates of foreign schools as interns, (c) that can fill most of their available intern spaces, (d) with high necropsy rates, and (e) that are relatively large. In competing for these good internships, UTCM graduates are quite successful. Nationally, about 60 percent of internships are in hospitals with medical school affiliations. About 80 percent of UTCM graduates in the last two years went to such hospitals for internship, indicating a high degree of acceptability. Almost all UTCM graduates receive internships in hospitals with no graduates of foreign schools serving in them on the house staff. Substantial majorities were accepted in hospitals able to fill more than 75 percent of their spaces. More than 70 percent went to hospitals with more than 500 beds, as compared with a national figure of only 41 percent of internships in hospitals with more than 500 beds. Thus on most of the generally accepted indices of internship quality, UTCM graduates get a larger proportion of good internships than the proportion available.

- Half of each year's class at UTCM is out of phase with the normal internship schedule. If December graduates (September entrants) wait six months for the National Intern Matching Program they lose one of the primary advantages of acceleration and biannual scheduling. In practice, however, most December graduates who want internships without delay can get them either in Tennessee hospitals or elsewhere. The process is somewhat more difficult outside the matching program, and some graduates may not get internships of first choice. Most physicians and administrators interviewed felt that it would be desirable to have greater flexibility in scheduling of internships, and such flexibility could be achieved without great difficulty if more medical schools operated on nonconventional schedules. Those UTCM graduates who do enter internships at times other than July, often feel that they get more individual guidance and can establish better personal relationships with supervisors than would have been the case if they had entered with a larger group. Few graduates had encountered any serious problems as a result of off-schedule graduation, and most welcomed the opportunity to start their internships at an earlier time.

- Hospital supervisors of intern and residency training were generally highly satisfied with UTCM graduates, and felt that they were as well prepared as graduates of most other schools, and with a desirable orientation toward practice.

- The dual admissions system has been a primary cause of faculty dissatisfaction at UTCM, and there have been both retention and recruiting difficulties in the past that are ascribed to the system. Under the semiannual system, teaching loads have in many instances been comparatively heavy, with the frequent necessity for faculty members to teach their courses twice a year instead of once as they would with annual admissions. Research time is, therefore, reduced. The problem is more acute in basic than in clinical science, since in the latter double scheduling increases but does not double the load. The load is, however, spread over a larger proportion of the year by dual admissions, and both teaching and laboratory facilities are more fully utilized. It would be impossible to instruct a single class of 200 in the present facilities, so the only alternative to dual admissions would be a reduction in enrollment. Faculty size has been increased in recent years, which has tended to mute criticism, and many faculty members do not feel overworked, although they may feel stressed by the fast pace brought about through acceleration. With acceptance of the necessity for enrollment at least

as large as it now is, most faculty members see the necessity for semiannual admissions, and have tried to overcome such instructional deficiencies as it may occasion.

- The volume of research output for the UTCM faculty does not appear to be substantially lower than that for other medical schools in most fields.

- The year around use of laboratory facilities is generally felt to be desirable, since laboratories function more efficiently in continuous use, and technicians can be hired on a full time basis.

- Double scheduling is thought to reduce curriculum flexibility and to increase the difficulty of making curriculum changes that require substantial faculty time for planning and execution. Such problems are, however, in large part due to the separation of basic sciences instruction from the medical school and the need to serve large numbers of nonmedical students.

- The dual admissions system increases the administrative load, but spreads it over a larger portion of the year.

- There is a close relationship between class size and the desirability and effectiveness of semiannual admissions. Most administrators feel that semiannual admissions are highly desirable, if not essential at some institutions, for classes larger than 150, where there are limits on classroom and laboratory facilities.

- The trend toward reduction in basic science hours and in time devoted to laboratory activities may make possible the use of multipurpose rather than departmental laboratories. Such laboratories can be more effectively employed with smaller classes of the size made possible by multiple admissions.

- Cost analyses are based on comparisons between UTCM and LSU. Costs were aggregated in various ways, but under any of the major expenditure classes, the costs per student were at least 20 percent higher at LSU than at UTCM for similar cost classes.

- Considering only the basic sciences portion of the undergraduate medical program, a cost analysis determined the relative expenditures needed to provide a given level of medical education if one or the other of the admissions policies were used. The result of the analysis showed that if instructional costs only are used, the cost per student at LSU is lower than at UTCM. With the inclusion

of overhead and depreciation, however, the reverse is the case. This is reasonable, since fixed or semifixed costs such as overhead and depreciation would not be expected to increase in proportion to the increased enrollment made possible by semiannual admissions.

This is the basis for the more favorable cost picture at UTCM and for the dual admissions system.

- If the relative costs of producing M.D.s at UTCM and LSU are comparable for the entire population of U.S. medical schools, semiannual admissions at all schools would produce 20 to 30 percent more physicians with no increase in expenditures.

III DESCRIPTION OF THE TENNESSEE PROGRAM

Introduction

UTCM is unique in the United States in admitting two classes per year. It differs from most other medical schools in certain other respects as well, but has great similarities in many categories also. In order to assess the effects of the dual admissions system that is the primary focus of this study it is necessary to understand other differences and similarities and their effects. In this section of the report the Tennessee program will be described in some detail, with particular emphasis on its differences from most other medical training programs.

The system combines dual admissions with year around operations. From 1930 to 1963 four classes were admitted each year at three month intervals. Two classes of approximately 100 students each have been admitted each year since 1963. The first enters in September, the second in March. The course of instruction is organized in six terms of 22 weeks each. The only substantial break period is one of about three months occurring between the third and fourth terms. Each year a four-week vacation is given in June and July, a two-week period in December, and short breaks in the Spring and Fall. Figure 1 shows generalized schedules of a standard curriculum and of the curriculum for the September and March entering classes at UTCM. The curriculum comprises about 5,000 scheduled hours (which is nearly average for most medical schools in the United States), is similar in content to most others, and is traditional.

The schedule permits receipt of the medical degree in approximately 39 months from entry. September entrants graduate in December; March entrants graduate in June. Teaching facilities are used fully on a year-around basis, which makes possible the instruction of twice as many students as could be accommodated in the existing facilities under standard scheduling and utilization. The multiple admissions system was started in 1930 primarily for the reason that it did permit more efficient use of facilities, and provided for the education of many more physicians than would otherwise have been the case. UTCM has one of the largest medical school enrollments in the United States, with substantially less facilities than most other institutions having comparable numbers of students.

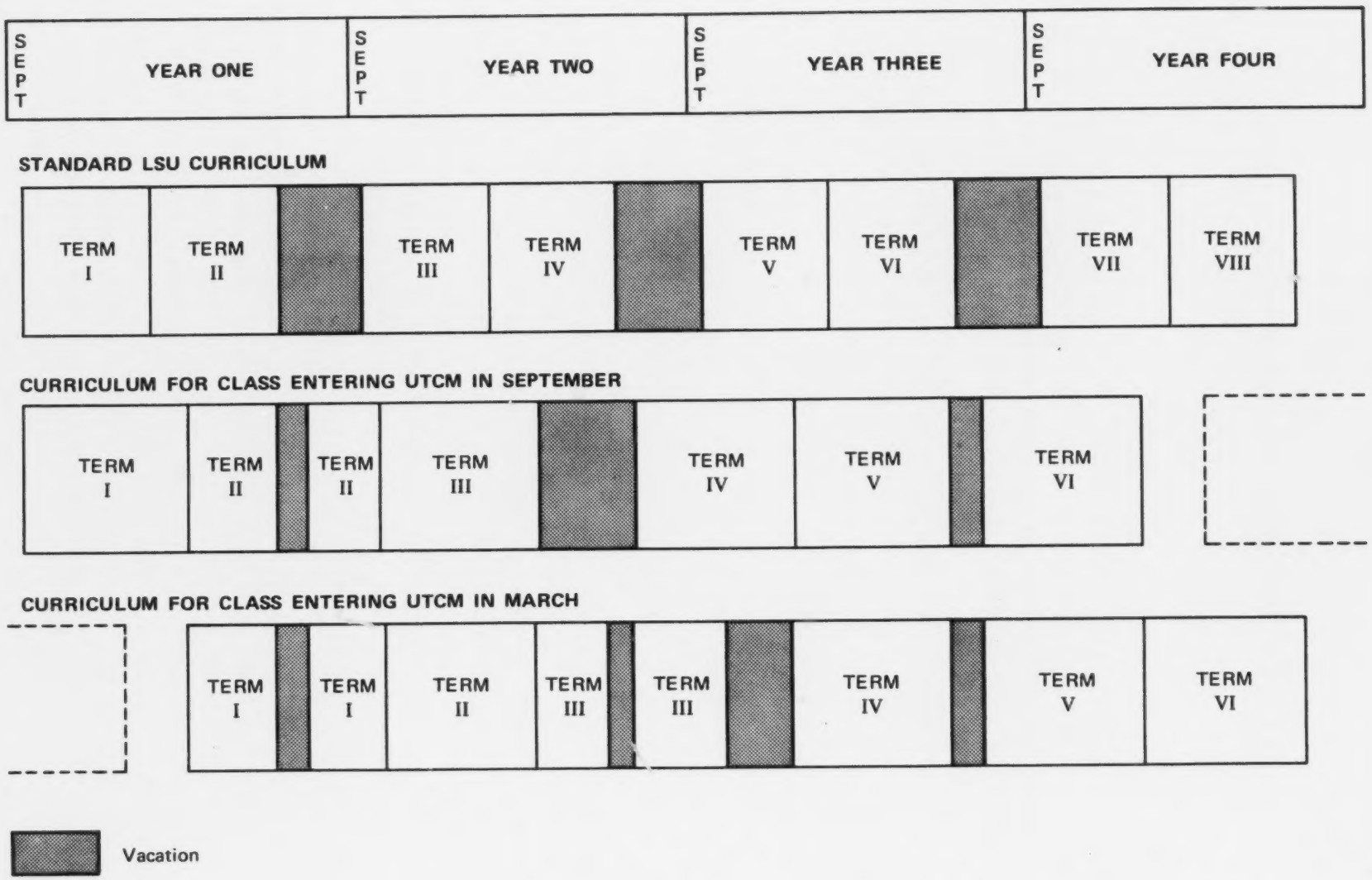

FIGURE 1 APPROXIMATE CURRICULUM SCHEDULES

As in the case of most other medical colleges, basic science instruction is given primarily in the first half of the program and clinical instruction in the second half. UTCM differs from most other medical schools in that basic science instruction is given by a College of Basic Medical Sciences operated separately from the Medical College under its own Dean. The college of Basic Medical Sciences also provides instruction for graduate science students, and dental, nursing, and pharmacy students. Instructional schedules for all of these other students differ from the schedules for medical students, causing complications in arranging the use of laboratory and lecture facilities to accommodate multiple use. Some courses may also be partially inappropriate for medical students since they must provide special material for the other categories as well. It has been recommended that basic science instruction for medical students be organized under the Dean of the Medical College with the provision of some separate facilities in order to obviate some of these problems.

Comparison of UTCM with Other U.S. Medical Schools

In implementing this study, the authors asked a number of individuals who were familiar with medical education in the United States to indicate what school or schools might reasonably be used for comparison purposes and as a rough research control for UTCM. The consensus was that LSU would be the most satisfactory for the purposes of the study. The schools are in the same region of the United States; quality and sources of applicants and student bodies are similar; curricula are similar; and levels of financing and other variables appeared to be comparable. LSU data were to be used primarily as a control for the cost analysis that will be presented in a later chapter, but certain other comparative information is presented here as well, as an aid to understanding the character of UTCM in relation to others.

The indicators used are (a) for all U.S. medical schools, (b) for a sample of 26 schools for which certain data were collected during 1966/67 or 1967/68, (c) UTCM, and (d) LSU. Whereas UTCM data are included for all indicators, LSU as well as all U.S. medical schools have data given for slightly over half the indicators to be used, and the 26-school sample is included in slightly less than half the indicators. (Most of the data used have come from four sources: (1) JAMA; education numbers;[1,2,3]* (2) an unpublished paper by Smythe;[4] (3) AAMC data, especially from the annual AAMC questionnaire; and (4) survey reports from the Liaison Committee on Medical Education.)

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* References are listed at the end of this report.

Table 1

STUDENT/FACULTY RATIOS

	All U.S. Medical Schools	LSU	UTCM
a. Undergraduate medical students	35,833	509	738
b. Full time faculty	23,014	211	327
Ratio of a/b	1.6	2.4	2.2
c. Medical students during first half of undergraduate medical school training	19,206	268	408
d. Full time basic science faculty	7,098	90	123
Ratio of c/d	2.7	3.0	3.3

Source: JAMA,[2] 1968/69 data.

Student/Faculty Ratios

The student/faculty ratios shown in Table 1 at LSU and UTCM are both substantially higher than the average for all U.S. medical schools. Moreover, LSU and UTCM are closer in their ratio than either is to the U.S. average. Taking only the basic sciences part of medical schools, UTCM has the largest student/faculty ratio and LSU is midway between that of UTCM and the all U.S. average of 2.7 for first and second year medical students per full time basic sciences faculty member.

Science Departments

Expenditures for three basic science departments are shown in Table 2. In general the big difference in expenditure patterns between UTCM and the average for the 26 schools is in expenditures per student for sponsored programs, i.e., programs paid for by outside sources, such as grants.

Table 2

EXPENDITURES PER STUDENT* IN THREE BASIC SCIENCE DEPARTMENTS

	Total Expenditures	Regular Operating Programs	Sponsored Programs
Physiology department			
26 schools†	$1,480	$ 441	$1,039
UTCM	1,080	322	758
Biochemistry department			
26 schools†	1,421	448	973
UTCM	748	381	367
Pathology department			
26 schools†	3,021	1,060	1,961
UTCM	1,310	646	664

* The data for University of Tennessee is for 1968/69, when there were a total of 738 students enrolled in the undergraduate medical school. The median number of students in the 26 schools was 335. This latter figure was derived from the median number of first-year students (90) and from the ratios of 2nd/1st, 3rd/2nd, and 4th/3rd year enrollments for all medical schools. These factors were multiplied by the appropriate part of the first year enrollment. For example, for the 2nd year enrollment we have 90 x 2nd/1st, for the 3rd year enrollment we have 90 x 2nd/1st x 3rd/2nd, and for the fourth year enrollment we have 90 x 2nd/1st x 3rd/2nd x 4th/3rd. The data are from university sources.

† Median expenditure for 26 medical schools from Smythe's study.[4]

Faculty Salaries

Changes in faculty salaries for all medical schools versus UTCM showed different trends for basic and clinical sciences, as indicated in Table 3. In the basic sciences the trend from 1964 to 1969 was for a

general equalization in the ratio of faculty salaries at all U.S. medical schools to those at UTCM, whereas in the clinical sciences the reverse took place--a general widening in the ratio between all schools and UTCM. This was caused by very small positive changes at UTCM. Table 4 shows the relevant ratios.

Table 3

ANNUAL FACULTY SALARIES*

	1964		1969	
	All U.S. Medical Schools (Median)	UTCM (Average)	All U.S. Medical Schools (Median)	UTCM (Average)
Basic sciences				
Chairman†	$19,100	$19,350	$26,500	$24,600
Professor	15,800	12,275	21,200	21,000
Assoc. Professor	12,900	11,865	17,200	18,000
Asst. Professor	10,600	10,002	14,000	14,000
Clinical science				
Chairman	28,300	30,700	36,800	30,000
Professor	23,300	21,400	30,100	24,000
Assoc. Professor	19,100	19,250	25,600	19,500
Asst. Professor	15,600	14,720	21,000	16,200

* Figures are average and median salaries paid to full time faculty by the schools. Fees for private practice are not included, except in a few cases for the University of Tennessee where clinical salaries have been adjusted for private practice payments. Data are from Ref. 5 and from 1964 and 1969 Survey Reports for the University of Tennessee from the Liaison Committee on Medical Education.

† Listed as "Chairman and Professor" for University of Tennessee.

Table 4

RATIO OF FACULTY SALARIES AT ALL U.S. MEDICAL SCHOOLS TO THOSE AT UTCM, 1964 AND 1969*

	1964	1969
Basic sciences		
Chairman	0.99	1.08
Professor	1.29	1.01
Assoc. Professor	1.09	0.96
Asst. Professor	1.06	1.00
Clinical sciences		
Chairman	0.92	1.23
Professor	1.09	1.25
Assoc. Professor	0.99	1.31
Asst. Professor	1.06	1.30

* Salaries at U.S. medical schools divided by salaries at UTCM.

Grants

Table 5 shows the teaching and training grants for six major departments at UTCM. The number of grants is determined by dividing the actual amount received by $25,000, so the number of grants refers to a uniform $25,000 grant.

Federal Salary Aid

UTCM has substantially less salary aid from federal sources than the average for all U.S. medical schools, and UTCM also has somewhat less aid in this category than LSU, as shown in Table 6. The big difference is in

Table 5

NUMBER OF TEACHING AND TRAINING GRANTS
FOR CERTAIN DEPARTMENTS
(One Grant = $25,000)

Department	Median for 26 Schools	UTCM
Physiology	3	5
Biochemistry	3	0
Pathology	5	8
Medicine	14	7
Surgery	7	3
Pediatrics	5	2
Total	37	25

Sources: Ref. 1 and Table 9 in Ref. 4.

Table 6

PERCENTAGE OF FULL TIME FACULTY WHO RECEIVED 50 PERCENT OR MORE OF THEIR SALARIED INCOME FROM FEDERAL RESEARCH OR TRAINING GRANTS (1968/69)

	Percentage
All medical schools[2]	
All departments	27.8%
Basic science departments	27.9
Clinical departments	27.7
University of Tennessee*	
All departments	20.2
Basic science departments	12.2
Clinical departments	25.0
Louisiana State University*	
All departments	24.1
Basic science departments	27.4
Clinical departments	21.5

* University sources.

the Basic Science departments, and from Table 7 it can be noted that all but anatomy and physiology share in this lack of federal support.

Table 7

PERCENTAGE OF FULL TIME FACULTY RECEIVING AT LEAST 50 PERCENT OF THEIR SALARIED INCOME FROM FEDERAL RESEARCH OR TRAINING GRANTS, BY BASIC SCIENCE DEPARTMENTS (1968/69)

Department	All U.S. Medical Schools	UTCM	LSU
Anatomy	19.8%	22.7%	20.0%
Biochemistry	35.3	10.0	22.0
Microbiology	26.7	10.5	0
Pathology	20.4	3.0	17.8
Pharmacology	36.0	0	28.6
Physiology	32.7	29.4	15.4

Source: Ref. 2.

Years of College Attended Before Entering Medical School, and MCAT Scores

Of the entering first year class at UTCM during 1968/69, 80% had four or more years of college completed. For LSU the percentage fell to 70; while the average for all medical schools (excluding Northwestern, Johns Hopkins, Pennsylvania State, University of Pennsylvania, and Brown University) was that 89% of the entering class had at least four years of college completed.

With regard to MCAT scores for entering students, for 1966/67 the overall scores (science part) for all accepted medical school applicants was 550, with a range of 444-631; while the mean score for accepted applicants at UTCM was 520.

Square Footage Occupied by Three Basic Science Departments

Table 8 shows the ratio of space occupied to the number of faculty members for the 26 schools and for UTCM.

Table 8

NET SQUARE FOOTAGE PER FULL TIME FACULTY

Department	(a) Net Square Feet Occupied		(b) Full Time Faculty		Ratio of a/b	
	Median for 26 Schools[4]	UTCM*	Median for 26 Schools	UTCM	26 Schools	UTCM
Physiology	13,000	37,000	10	14	1,300	2,643
Biochemistry	13,000	48,000	11	12	1,182	4,000
Pathology	23,000	59,500	16	30	1,438	1,983

* University sources.

Course Content

Table 9 shows the general course content similarity between UTCM and LSU. Courses are given for the first three terms at UTCM and the first two years at LSU.

Certain of the comparison factors discussed above have obvious relevance to the general problem of providing more physician manpower, which is the focus of this study. The semiannual admissions system is the one most significant variable to which the study is addressed, but faculty size, student-faculty ratios, total number of students, level of financial support, acceleration and other scheduling, facilities availability, and student input characteristics must also be considered and isolated to the extent possible in trying to assess the advantages and disadvantages of the dual admissions program and its applicability to other institutions.

Table 9

COURSE EQUIVALENTS AND HOURS
(Includes Laboratory and Lecture Hours)

	LSU (Years 1 and 2)				UTCM (Terms I, II, and III)			
	Course Number	Year Taken	Hours	Percent Total Time	Course Number	Term Taken	Hours	Percent Total Time
Anatomy	211, 221 Neuro-science 211	1 2	553	26.6%	1, 2, 3, 4, 5	I II	565	26.9%
Biochemistry	211	1	216	10.4	1	I	220	10.5%
Clinical correlation Conferences	Clinic	1	36	1.7	Conferences	I, II and III	15	0.7
Physiology	211	1	203	9.8	1	II	253	12.0
Psychiatry	211 221	1 2	72	3.5	1 2	I II	44	2.1
Statistics	Biometry 221	2	54	2.6	Preventive Medicine 1	II	22	1.1
Medicine	Physical Diagnosis 221 Dermatology 221 Surgery 221	2	252	12.1	Medicine 1,2,3. Pediatrics 1 Preventive Medicine 2,3	III	275	13.1
Microbiology	221	2	121	5.8	1	II	198	9.4
Pathology	221 and 222	2	405	19.5	1	III	297	14.1
Pharmacology	221 and 222	2	140	6.7	1	III	187	8.9
Radiology	221	2	21	1.0	1	II	22	1.0
Library	221	2	6	0.3		I	3	0.2
Total			2,079	100.0%			2,101	100.0%

Source: Catalogs of LSU and UTCM, 1970.

IV ADVANTAGES AND DISADVANTAGES OF THE SEMIANNUAL ADMISSIONS SYSTEM

Methodology

The study was carried out by means of a number of techniques of interviewing and records searches.

Administration, faculty, students, and graduates of UTCM were interviewed in depth to acquire their attitudes, opinions, and assessments relative to the dual admissions system. The complexity of the medical school, the interaction of the semiannual admissions system with many other variables, the importance of personnel attitudes, and other factors made it essential to use face-to-face interviews, with sufficient time allowed for detailed discussion, so as to get the evaluative information that was required. Interviews were directed in a general way by the topic guide that appears in Appendix A. This guide was used by the interviewer for his convenience and was not submitted to the interviewee to be filled out. The guide was prepared after an initial series of interviews at UTCM, and was based on those interviews and a survey of relevant medical education literature. It includes questions relevant to all significant factors concerned with dual admissions and physician output. None of the items was used with all respondents, since obviously some were inappropriate for certain categories of personnel who could not be expected to have knowledge concerning them. Interviewers (the authors) were thoroughly familiar with the guide and with the information to be obtained, so they did not always use the guide in the same sequence, and did not always phrase questions in the same way. In that way topics of particular interest to each respondent could be explored as they arose naturally in the course of each interview. Before completing each interview, however, it was insured that no items for which each respondent could be expected to have information were left out. Notes were kept and topic summaries prepared after each series of interviews. There were no tabulations, because of the wide-ranging nature of the questions.

Medical educators or those knowledgeable about medical education from other institutions and agencies were also interviewed to obtain their views on the problems of increasing physician output and on multiple admissions systems. Personnel from The Association of American Medical Colleges, the National Institutes of Health, and a number of medical schools were interviewed for this purpose. Some faculty members who had

taught at UTCM, but are now teaching elsewhere, were included. As in the previous instance, the interviews were guided in a general way by insuring that relevant topics were covered in all cases, and summaries were prepared.

Financial and other records at UTCM and LSU were examined, abstracted and subjected to various kinds of analysis (discussed in Section V) as a part of the evaluation.

Graduates now in internship or residency were interviewed in the hospitals in which they are serving in order to determine their views on the quality of the education they had received in the perspective provided by hospital service, and to ask them to compare their own training with that given those from other institutions with whom they are serving. Consideration was given to surveying all graduates of the dual admissions system by mail, but this plan was rejected on the grounds that sufficient depth could not be obtained with a mailed questionnaire on the kinds of complex questions at issue, and that more lengthy interaction was required to get the information needed. Further, the first graduates of the system obtained their degrees in 1967, so none are yet established in independent practice, and their limited experience makes it difficult for them to make rigorous comparisons with graduates of other schools or to assess any shortcomings in their own training. In the circumstances, interviews were essential, and they were carried out in a number of locations, including San Francisco, Los Angeles, Dallas, Washington, D.C., Boston, New Orleans, and Memphis. No one hospital or location had any large number of UTCM graduates, and time and travel limitations prohibited visiting a large number of locations. However, the relatively small sample of graduates interviewed did provide much valuable information.

In each hospital where graduates were interviewed, their supervisors were also interviewed to get their assessments of the quality of UTCM graduates as compared to those from other schools. These interviews provided the best measures of physician competence that were obtainable for the study, since respondents were frank and quite willing to provide detailed assessments based on their observations. As mentioned above, no one institution has a large number of graduates (the largest number was six), so supervisors had a limited basis for comparison, but nothing more extensive was obtainable.

Background for the Evaluation

As previously mentioned, UTCM changed in 1963 from a system of four classes admitted a year to two classes a year. This was done because of great dissatisfaction on the part of many faculty and staff members, and some unfavorable comments in accreditation reports. Some of the same criticisms from both faculty and accreditation reports have been applied to the dual system and many faculty, administrators, and students have recommended conversion to an annual system. Present facilities would not permit such a change without reducing enrollment, which is out of the question. Those who have objected to the present system are aware of that reality, and have asked that the State explore ways and means of obtaining funds for new construction, some of which is needed in any case.

In the course of their discussions about possible changes in the admissions system, the faculty prepared lists of positive and negative aspects of the program. These lists were one of the sources used by the study team in determining the information to be sought in interviews and through records searches. The lists will be presented here as a background for the study evaluation.

- Factors favoring the semiannual system:

  - More efficient utilization of time and shorter total time for achievement of the M.D. degree.

  - More flexibility in admissions and curriculum.

  - More economical to the student, since 13.5 percent less time is spent in residence.

  - More efficient utilization of space and equipment.

  - The penalty for illness, failure, or fatigue is less since students do not have to make up an entire year, but only one six-month term in most cases.

  - The saving in time and cost may help attract more moderate and low income students into medicine.

  - Classes are half the size they would be under an annual system, so there is more faculty contact and more of an opportunity to use essay as well as objective examinations.

- Factors opposed to the semiannual system:

  - The schedule is out of phase with college graduation.

  - The schedule is out of phase with house staff training programs.

  - Curricular time cannot be expanded.

  - Failing students cannot make up the failure, because there are no summer intervals in which to do so.

  - The faculty has little time to rework and upgrade courses.

  - There is a high rate of class irregularity (dropping back into another class).

  - There is too little schedulable time.

  - The two yearly classes differ in capabilities because of the manner of selection (the best applicants are taken for the September class).

  - Faculty must give lectures twice a year instead of once.

  - Students and faculty are under excessive strain and fatigue because of year-around operations.

  - There is a lack of flexibility (no opportunity for summer clerkships, for example).

  - Elective and research opportunities for students are limited.

  - Some proportion of March entrants are ready in September, and therefore lose time.

  - A smaller proportion of the March than of the September entrants have Bachelor's degrees; some might have obtained those degrees with a few months additional work.

  - Vacations occur in the middle of terms (see Figure 1).

It should be noted that some of the problems specified may not be a result of the dual admissions system itself, but rather of acceleration, curriculum deficiencies, and faculty shortages. In the following discussion of the findings of the study, wherever possible, problems will be

discussed in terms of their most probable causes, and the relative contribution of the various facets of the UTCM system to each difficulty will be assessed. In some cases it will not be possible to do this since the system is a complex interacting entity.

The findings will be discussed in terms of their relevance to certain personnel and operational categories, including applicants, students, graduates, faculty, and College operations. The financial analysis will be separately presented in Section V.

Applicants

The majority of applicants to UTCM are from Tennessee. As is the case with most other State supported medical schools, state residents are given preference in admissions. In 1965-66, for example, there were 313 applicants to medical schools from the State of Tennessee, 184 of whom received one or more acceptances. Of these, 137 (70 percent of the class) were accepted and enrolled at UTCM.

Applicants are encouraged to obtain Bachelor's degrees before medical school admission. About 80 percent of those enrolled have done so. This compares with the national average of almost 90 percent for holders of degrees in freshman medical classes.

Average MCAT science scores for accepted applicants is 520, which is in the fourth quartile for U.S. medical schools. Scores for accepted students at UTCM are about the same as the national average for all students taking the test. There is a smaller difference between the average scores for those applying and for those accepted at UTCM than there is nationally. The degree of selectivity is, therefore, lower. The lower selectivity is reflected also in the fact that the percentage of Tennessee applicants who are accepted is among the highest in the United States, so that some are accepted who might not be at other schools. The acceptance ratio is determined largely, of course, by the size of the applicant pool and the number of first year spaces available.

Undergraduate colleges and universities from which applicants come vary a great deal in quality. A bonus and penalty system based on a formula taking into account average MCAT scores of applicants from each school is used to equate schools for selection purposes. The largest single proportion of entering students (24 percent) is from the University of Tennessee. Memphis State is the next largest source with some 10 percent. Some 36 undergraduate institutions are represented, many of them with only one student. About 62 percent are from institutions classified as "universities."

MCAT scores show that the entering student body at UTCM is slightly below average for southern schools, about the same as that for southern state schools, and considerably below the national average. There have been indications of improvements in the situation every year for the last few years, although gaps between UTCM and other institutions have narrowed very little (if at all) in some respects.

The relationship of quality of entering students to the effect of the semiannual admissions program is not clear, but it seems probable that the acceleration might tend to put more stress on lower quality students than on those of greater capacity.

One effect of the semiannual system in practice is that the two entering classes tend to be of somewhat different quality. Tennessee residents and those ranking higher on most selection criteria are usually placed in the September class. Out-of-state applicants and those of lesser capability, as well as those whose other academic schedules did not permit entry in September make up the March class. Many faculty members feel that the September class is superior and that they should alter instructional methods and the time devoted to preparation and counseling to take account of these differences in the two classes. Some do not regard this as a serious deficiency, and, in any case, the classes could probably be equalized with some relatively minor changes in admissions policy, so long as eligible Tennessee applicants were accommodated in one class or the other.

The larger classes permit taking more out-of-state applicants, which contributes to the breadth of experience and background of the student body.

There is no lack of applicants for the March class, since undergraduate college acceleration is becoming quite common.

Students

As indicated above, accepted applicants at UTCM are of lower academic quality, as measured by various indices, than the national average, although roughly comparable to most southern state schools.

There are 5,077 total hours of instruction in the medical curriculum, which is about average for medical schools in the United States. Of these, 374 (7 percent) are elective hours. This is substantially less than the proportion of elective time offered in many other medical schools, but more than in some others. All of the elective hours are included in the sixth

and last term at UTCM. One elective sequence occupying 154 hours is in one of several surgical subspecialties. The other is a University Elective in any basic or clinical field the student chooses, including the alternative of a preceptorship with a family physician.

Students are encouraged to participate in research programs in order to develop investigative skills thought to be useful for all physicians. Research is, however, on a voluntary part-time basis. It is not required, and there is no exemption from any regularly scheduled classroom or clinical work.

Opportunities for electives or research are somewhat limited, and the accelerated schedule permits very little free time for student participation. Some students occupy the one three-month vacation period for research. Others can and do use the period between December graduation and internships obtained through the matching program for research, although there is limited financial support for such students during that period. The net result is that most UTCM students do very little research during their undergraduate careers.

In many other medical schools, summers are used by students to earn money necessary to support them through their medical course. This is not possible, except for the one summer period, at UTCM. However, graduation earlier than is the case on a conventional schedule makes it possible for students to start earning money earlier as well.

UTCM is in the first quartile as compared with other medical schools with respect to the total number of full time faculty, which is 342. Because of the large number of undergraduate medical students (744), however, the student/faculty ratio is 2.2 students for each full time faculty member. This ratio is in the third quartile for all four-year schools. This makes for some limitations in the amount of student-faculty contact, but the problem is alleviated to a considerable degree by the division of each class into two yearly increments of about 100 students each. In a single class of 200, being given simultaneous instruction, little or no student faculty contact would be possible on an individual basis. Division into two classes, made possible by semiannual admissions, does increase the capability for such contact, and most students and faculty members who were interviewed felt that contact was adequate, so that academic difficulties could be detected in a timely fashion and corrected before serious harm was done. Students, generally, felt that faculty members were available for individual consultation when they were needed and for as much time as was required. The smaller class size does permit these contacts during the period of instruction by a given faculty member that might not be permitted in a larger class. For the faculty

member who teaches a course twice a year, the amount of time he spends in individual student contact may be larger than would be the case for a single larger class. Most faculty members, however, feel a substantial responsibility for individual counseling, and welcome the opportunity created by the smaller class to provide it.

The gross attrition rate is about 11 percent, which is somewhat larger than the national average of 6.7 percent for 1969-70. The national average has declined every year for the last three, but UTCM's has remained stable. Academic failure accounts for about half of the rate, with the other half being due to illness, psychological problems, and decisions to seek careers in some field other than medicine. There have been no known withdrawals for financial reasons, but many students have financial problems. This accounts for a fairly high volume of outside work by students, which may be a contributing factor to lessened academic achievement, irregularity, and failure.

Dropping back from the class of entrance to a later one (irregularity) is common. The rate is about 30 percent, which is higher than that for all other medical schools in the United States. This results primarily from the impossibility of summer make-up work, which is prevented by the accelerated schedule. The failing student has no alternative but to join another class. Where there are strong class loyalties, as is the case with most medical students, dropping back may have a deleterious effect on morale. Failure rates are closely related to the quality of students admitted, which, as has been mentioned, is low at UTCM. The failure rate at UTCM for those with MCAT averages of 455 or higher is 3.4 percent, and for those with averages of 455 and below it is 10.5 percent. Rates are also positively correlated with premedical averages, and are related to the schools from which the student comes. Students from schools sending significant numbers of students to medical schools have only half the failure rate of students from schools sending small numbers to medical schools. Failing students also tend to be somewhat older (three years on the average) than successful students.

Student performances on Part I of the National Board of Examiners tests covering basic medical sciences were approximately equivalent to that on the MCAT admission test, falling in the last quartile, during the period when passing the test was a prerequisite to entrance to clinical training. It is not now required. They perform somewhat better on the Part II, clinical sciences examinations, when those are given.

Deficiencies in performance of UTCM students appear to be more related to the quality of the input to the school than to any difficulties brought about by either semiannual admissions or acceleration. The total

number of students and the class size do not appear to be factors either, since high failure rates appear in schools with small enrollments as well as large.

Medical students are a very important part of patient care capability in a teaching hospital. In conventional medical training schedules it is very difficult to compensate for their not being available in the summer. The Tennessee system avoids this problem.

Student attitudes toward the UTCM program are generally favorable. Students were interviewed in groups and individually to determine their reactions to various aspects of the program. Few of the students had had any experience with other medical schools, so they have no basis for comparison, but that fact does not invalidate their attitudinal responses to the course of study. It should be noted that the great majority of UTCM students are primarily interested in becoming practitioners, with a more than usual interest in general practice. This should be kept in mind in considering the following discussion of opinions and attitudes.

Some few students felt keenly the lack of opportunities for student research necessitated by the accelerated schedule and the large number of students. They felt that there was almost no time to come back to the laboratory to conduct independent or collaborative research activities, and that in any case the laboratory facilities were often scheduled for use on an almost full time basis. Most students did not, however, feel the lack so strongly. This may be accounted for by the orientation toward practice rather than research of most students, and by their inability to recognize the importance that research knowledge and experience might have for a practitioner. Lack of research experience might be recognized as detrimental at a later time when the physician has had more experience, but not while he is actually in medical school. In any case, the limited opportunities for research under the UTCM schedule do not seem to most students in the school to be a serious deficiency.

A substantially greater number of students do feel the need for more elective time. This is in keeping with a general trend in higher education for greater individualization of instruction and individual choice. Curriculum changes are being discussed and planned at UTCM, and one of these calls for a full elective term, probably the last one. This is in keeping with curriculum changes made at other medical schools in recent years. There is also a proposal for a bridge term, mixing required and elective courses between the regular curriculum and the full elective term.

If a six-month elective term were added to the present curriculum rather than being substituted for some of the current material, most students would react unfavorably. Some said that they would have gone elsewhere if there had been an additional term. Such an addition would have a seriously damaging effect on those students admitted in March, who might lose an entire year because they could not get into the matching program at the normal time. Almost all students feel that once they have completed the required number of hours, they should move on to internship and their full practice careers. Further delays would be costly in time and money, and would not provide them with any additional material that they think they need at this stage in their progress. Many believe that the important part of their education comes after the degree in any case, and they want to get on with it as rapidly as possible.

Faculty contact was felt to be adequate by most students interviewed. They felt that they could usually get counseling and assistance when it was needed, but that this might not have been the case if they had been in one class of 200 rather than two classes of 100 each. From the student's point of view, semiannual admissions are a positive advantage in this sense. However, there is more personal contact in electives, and these are limited at UTCM as previously mentioned.

The stress brought about by acceleration was not felt to be excessive by most students interviewed. They welcomed the opportunity to complete their training in less time than normal. Most believe that motivation and personal characteristics determine response to stress, that any medical program is stressful, but that given proper motivation most students would not be unduly stressed by the UTCM schedule. Those who are married, especially if they have children, feel that the program gives them little time to spend with their families, but recognize that a more conventional schedule might not help much in this respect, and that the UTCM program has the advantage of saving time overall.

Many felt that the lack of summers off to make up academic deficiencies was not a serious lack, and that most drop-backs would have dropped back in any case, even on a conventional schedule. Not having summers off to make money is a more serious problem, but it is felt to be compensated for by earlier completion of the medical course. Medical students do tend to have a strong class sense. The lack of make-up time in the summer prevents some students from continuing with their classes and is in large part responsible for the high irregularity rate. On the other hand many students and staff members feel that the ability to drop back for only one six month term rather than a full year, as in an institution with conventional scheduling, makes it possible to salvage some students who would have dropped out altogether with the longer delay. Some, of course, may drop back who would not have done so if the loss was an entire year.

Both students and staff react unfavorably to the existing separation of basic sciences in an independent school. Students feel that they are under too much control of the basic sciences faculty. Attendance in the same classes with graduate science students means that courses are not as well tailored to medical student needs as is desirable. The goals are different and courses and examinations should also be different. The basic sciences faculty tends to be overworked in this situation, and this reduces the amount of student faculty contact, although, as previously stated, students are satisfied with the amount of contact they have.

Graduates

The effectiveness of graduates of medical programs is difficult to evaluate in any rigorously objective fashion. The problem is particularly acute in this study because most graduates of the semiannual admissions program are still in internship or residency and are not, therefore, in fully independent practice. It was determined that the most appropriate way of getting the necessary information for the study was by means of interviews with UTCM personnel concerned with internship placement, with graduates themselves, and with those in hospitals who supervise graduate training. In addition, estimates of the quality of internships obtained by UTCM graduates were taken as a measure of their acceptability. Since graduates are still in internship or residency, a number of potentially useful indices of physician performance, including type of practice or other activity, place of practice, national specialty board scores, and earnings were not relevant for the study purposes. Consideration was given to surveying graduates by mail to get their own estimates of competence as compared to graduates of other institutions. This procedure was, however, rejected, on the grounds that their limited experience in practice and in observing the graduates of other schools would not permit them to evaluate themselves in a valid fashion. Information of this sort was sought in interviews where face to face interaction made possible exploration of the questions in greater depth, and these results will be presented for any value they may have.

All findings should be viewed in terms of the practice orientation of most UTCM graduates, and the fact that UTCM has a larger proportion of students going into general practice than most other U.S. medical schools.

A commonly used measure of the quality of training given medical students is the character of the internships for which they qualify and that they receive. There is competition for the "good" internships, and the extent to which the graduates of any medical school compete successfully

is a measure of the effectiveness of their training. The following criteria are generally agreed to define "good."

- Internship at a hospital affiliated with a medical school, especially if the hospital is a major teaching unit of the school
- Internship at a hospital with a small percentage of graduates of foreign medical schools serving as interns
- Internship at a hospital able to fill most of its available intern spaces
- Internship at a hospital with a high necropsy rate
- Internship at a relatively large hospital

Records of the 1969 and 1970 internships received by UTCM graduates were analyzed, using the above criteria, to determine how well the graduates were able to compete with the graduates of other medical schools in getting good internships.

About 59 percent of the 1969 graduates and 68 percent of the 1970 graduates accepted internships in the middle Atlantic and southern regions of the United States, although only 19 percent of the internships available in the United States are in those regions. In 1969, 32 percent interned in one of three hospitals in the city of Memphis. For 1970 the figure is 45 percent. This is what might be expected in view of the location of UTCM, and it has no particular bearing on the question of internship quality, except as it relates to the question of how inbred UTCM graduates may be.

Hospitals with approved graduate training programs, that are affiliated with medical schools, are classified in one of three levels. The first classification is for hospitals that are major units in the teaching program of a medical school. Within this category, the hospital may either be owned by the school, hospital and school may be jointly owned by the same organization, or, if the school does not own the hospital, it has the exclusive right to appoint or nominate all members of the hospital staff assigned to services used by the school for teaching. In the second category are hospitals that are used to a more limited extent in the school's teaching program. The third category is for those hospitals not falling into the first two, but that are used by the school for graduate training programs only. This may include selection of the house staff by members of a specific medical school department or by a joint committee of medical

school and hospital, exchange of residents between the hospital and principal medical school teaching hospital, regularly scheduled participation of faculty in teaching programs at the hospital, or a contractual agreement for medical school assistance in the organization and supervision of the graduate program in the hospital. Nationally some 60 percent of internships are in hospitals affiliated with medical schools in one of those three categories.

In 1969, about 60 percent of UTCM graduates received internships in hospitals in the first category (major units in a school's teaching program), and 14 percent and 9 percent respectively went to hospitals in the other two categories. Thus a total of about 83 percent got internships in hospitals affiliated with medical schools and only 17 percent in nonaffiliated hospitals. Comparable percentages for 1970 were 53 percent, 21 percent, and 5 percent, with 21 percent going to nonaffiliated hospitals. In both years, therefore, UTCM graduates achieved a substantially larger proportion of internships in affiliated hospitals than the national percentage of affiliated internships available, indicating a high degree of acceptability by those making internship placement decisions.

In 1969, 94 percent of UTCM graduates were placed in hospitals with less than 25 percent foreign graduates serving as interns. The comparable figure for 1970 is 98 percent. For both years, almost all of the graduates went to hospitals with no graduates of foreign medical schools serving as interns at all. This is another indication of high acceptability of UTCM graduates in terms of their competitive ability to get good internships.

On the criterion of service in hospitals that are able to fill a substantial proportion of internships offered, Tennessee graduates also do well. In 1969, about 59 percent went to hospitals able to fill 75 percent or more of their internship spaces. Another 22 percent went to those filling from 51 to 75 percent, and 19 percent to hospitals filling less than 50 percent of those available. Comparable figures for 1970 are 72 percent, 18 percent, and 10 percent.

The average necropsy rate in hospitals to which 1969 UTCM graduates went as interns is 42 percent. For 1970 the average is 46 percent.

In 1969, UTCM graduates went to hospitals with an average of 798 beds. For 1970 graduates, the average is 793. About 72 percent of 1969 graduates went to hospitals with more than 500 beds. The figure is 74 percent for 1970. Nationally, only about 41 percent of internships are in hospitals with more than 500 beds.

On all of the generally accepted indices of internship quality UTCM graduates show up well, in some cases achieving a larger proportion of good internships than the proportion of such internships available.

One of the major questions that has been raised about the UTCM semi-annual system is the fact that half of each year's class is out of phase with normal internship schedules, so that December graduates must wait six months to begin internships if they wish to participate in the matching program. Since most of this group of graduates were September entrants, the delay eliminates the primary advantage of acceleration, because they may not enter internship until the same time as those on a more conventional schedule do so. The time can be used for research or preceptorships, and some few students do use it for those purposes. Others get jobs in order to make a little additional money. The other alternative is to seek internships outside of the matching program that can be started in January or February so as not to lose time. In some cases such internships are extended to 18 months, so that no time is saved, but additional valuable hospital training is received.

Most hospitals in Memphis and in other parts of Tennessee are prepared to accept interns at times of the year other than July, and many hospitals in other parts of the country will do so also, since all of their spaces may not have been filled, and they need interns whenever they can get them. The upshot of this is that almost all December graduates who want internships outside the normal schedule can obtain them. The process is somewhat more difficult because they cannot take advantage of the organized, well-administered matching program system. It may also mean that they cannot try for internships at some hospitals of their choice because those hospitals can accept interns only at the normal time. Acceptance at midyear in a hospital whose training program is organized and scheduled for July entrants is sometimes possible, but it may mean that the intern will miss some of the training that he should have had. One large hospital that takes a substantial number of interns and welcomes UTCM graduates has organized its program so that interns can be accepted at any time of the year by programming on a monthly basis. The training content is the same, but there is a greater degree of flexibility in employment and assignment of house staff. Finally, out of phase residencies may be more difficult to arrange than out of phase internships.

The consensus of most physicians and administrators interviewed in the study is that while medicine is not now geared for the easy acceptance of interns at times of the year other than July, it might be highly desirable if there were greater flexibility in scheduling. It is commonly said, although not widely documented, that mortality rates in emergency rooms always rise in July, when the intern staff is all inexperienced.

Even if this is not the case, it appears probable that hospital functions involving interns must be generally less efficient and effective when the staff is inexperienced than later when it is more practiced. In those hospitals that do accept off-schedule interns, functions should be performed more smoothly throughout the year, and interns who have been on staff for a few months may provide a stabilizing influence and can assist, by example, in the training of newer ones.

If more medical schools had schedules similar to that of Tennessee, more hospitals might alter training to accommodate interns at different times, and general functioning might improve. The matching program would have to be run more than once a year, and some of its operations would have to be changed, but presumably that could be done if there were sufficient motivation.

Large hospitals with large numbers of interns have less difficulty in accepting interns in January than do small ones, and some regard it as a positive advantage to mix January entrants with more seasoned personnel instead of having to start the entire staff at one time. January entrants may have more time to make a specialty decision, with a better chance of avoiding the problem of choosing a specialty later determined to be unsatisfactory and having to start over again. One hospital training director felt that he was able to establish a better personal relationship with those interns who came outside the matching program, since they were personal choices. The improved personal relationship helps the intern to get a good start and generally facilitates training.

UTCM administrators feel that their graduates get good internships and residencies and that they usually obtain ones that, even if not first choices, are nevertheless quite satisfactory to them.

Graduates who were interviewed expressed little dissatisfaction with the internships they had obtained. Arrangements were, of course, somewhat more difficult outside the matching program for those who did not participate, but none felt that it had been a serious problem. Most felt that ample choices have been available to them, that January entry provided valuable additional time and experience, enhanced opportunities for personal contact, and more individualized training than would have been possible if they had entered with a larger group.

Graduates Self-Appraisal

Graduates felt that they were fully as competent as most of the graduates of other schools, and could specify few deficiencies in their

training. On the basis of their experience as interns and residents, some felt that they might have profited by having more electives and additional research opportunities in medical school, yet many felt that they might not have taken advantage of additional research and elective opportunities if they had been available because of their practice orientation. Many feel that the most important part of medical education occurs as house staff members in any case, and that the UTCM program was entirely adequate to prepare them for their hospital training, with the added advantage that most of them could begin internship sooner than students not on accelerated programs.

There was some feeling of subjection to a substantial amount of stress in the basic sciences curriculum, but not as much in the clinical. They also felt that basic sciences training should have been geared more specifically to medical student needs. This, of course, is a function of the organization of UTCM rather than the semiannual system or acceleration. Graduates were generally satisfied with the amount of faculty contact they had had. They preferred the classes of 100 rather than 200 since the smaller size enhanced opportunities for counseling, remedial assistance, and general faculty interaction.

Almost without exception, graduates were glad that they had gone through an accelerated program even though it increased time and work stress and did not provide free time for rest or money-making. They are anxious to get out and begin their careers, and the UTCM schedule expedites the process. They do not favor adding a term for any purpose.

Laboratory facilities were felt to be adequate, although heavily used, notwithstanding the lack of interest in research exhibited by most of those interviewed.

Hospital Supervisor's Appraisal of Graduates

Hospital supervisors of intern and residency training were generally highly satisfied with UTCM graduates and rated them as fully competent as graduates of other schools. It should be noted that many tend to view formal medical school training as much less important than later training and experience in preparing practitioners, and they often feel that few medical school graduates, no matter what schools they come from, are very competent or knowledgeable in any case until they have been seasoned by practical training. Industry, integrity, and conscientiousness are regarded as the most important factors leading to successful practice, and UTCM graduates are generally rated high on those variables. Hospital supervisors regard the Tennessee emphasis on practice rather than research as

highly appropriate. They appreciate the fact that clerkships at UTCM provide ample opportunities for students to see and help with the diagnosis and treatment of a wide variety of disorders. UTCM is seen as providing good basic training and producing graduates who exhibit similar levels of competence with few that are outstanding and few that are seriously deficient.

Deficient personalities and personal orientations are regarded by many supervisors as having a much greater impact on medical competence than basic school training unless it is grossly inadequate. Some graduates of prestige schools with brilliant records can never function satisfactorily as physicians because of problems of personality and temperament. It is difficult for schools to weed them out, so the problem is passed on to those providing hospital training. UTCM graduates are seen as having a smaller proportion of such problems than do graduates of many other schools.

Many training supervisors are not greatly concerned about the lack of opportunity for student research at UTCM, since they do not feel that it seriously affects the competence of interns and residents. Some do not see the need for heavy emphasis on electives, especially in the fourth year and would prefer to see much of the fourth year curriculum eliminated in favor of earlier entry into internship.

Faculty

Information presented in this section comes from interviews with faculty members and administrators at UTCM, LSU, Tulane University, George Washington University, and Boston University. At Tennessee the faculty of both the College of Basic Medical Sciences and the College of Medicine--at levels from Department heads to relatively junior professors--were interviewed. Their experience at UTCM ranged from 2 to more than 30 years. Also included in interviews were a number of faculty members at other institutions who had taught previously at UTCM.

As mentioned previously, there is a movement toward establishing a single admissions system at UTCM, backed primarily by faculty members. Some members assert that there have been substantial difficulties in both retention and recruiting that they ascribe to the semiannual system with its requirement that courses be taught twice a year instead of once. It is impossible to document these assertions, and they are not supported by all members of the faculty. However, there is substantial faculty dissatisfaction, or at least there was in the years before the last two. The dual admissions system has been a primary cause of the dissatisfaction,

although for those who taught previously under the quarterly system, the inception of the biannual system was a considerable improvement. Other sources of dissatisfaction are the smallness of the faculty relative to the number of students, and pay scales. Substantial improvement in both of the latter factors has been made in recent years, which probably accounts for the apparent reduced faculty dissatisfaction.

The key question relating to semiannual admissions is that of teaching load. The question is complex, however, because teaching load is also affected by acceleration, class size, and curriculum variables. In most medical schools, the tradition has been that instructors might teach one or two courses a year, often occupying only a few months' time, with the rest of their time spent in research activities. Additional teaching, brought about by any of the factors mentioned, necessarily reduces the time available for research. Faculty members usually want to continue research to as great an extent as possible and often regard it as an essential part of medical education as well. Thus, anything that reduces the time and effort they can devote to research is seen as undesirable. The UTCM system tends to put a heavy emphasis on teaching. There is, however, great individual variation in loads among faculty members.

Teaching loads affect basic science and clinical faculties differentially. In basic science, an increase in teaching inevitably means a proportionate reduction in research. Clinical instruction is usually spread over the entire year in any case, and much of it is in nonlecture form, so that additional students do not bring about a commensurate increase in teaching time, although they may require some additional facilities. Further, in some areas of clinical science, such as surgery, there is often less interest in research and less time devoted to it by faculty members. The result of this is that most of the complaints about increased teaching loads come from the basic science faculty. At UTCM, the situation is further complicated by the heavy commitment basic science faculty members have in instructing dentistry, nursing, and pharmacy students and science graduate students. Dual admissions does spread the basic science load over the entire year, which is advantageous. Teaching a course twice a year instead of once does not increase preparation time appreciably, but it does increase the time for preparing and grading nonobjective examinations. This leads to a greater use of objective tests, a use that some see as excessive.

Faculty members who are concerned about the increased teaching loads not only from the point of view that it reduces the time they can devote to research, but also because they may feel they cannot serve the large number of students adequately even in two increments, are, of course, aware that it would be impossible to instruct a single class of 200 in their

present facilities, although some suggest that greater use of audio-visual technology and such innovations as team teaching would permit effective instruction of larger classes. Annual admissions would require an enormous increase in facilities with no increase in the number of students and little increase in quality. The semiannual system does make the best use of existing facilities. Semiannual admissions is thus the only alternative to reducing enrollment, which cannot be done for a variety of reasons. The school has undertaken to increase faculty size substantially, to reduce teaching loads, and to increase salaries in order to retain and attract the faculty needed for an effective instructional program.

It is the opinion of many faculty members that they are not really overworked, but have simply become accustomed to a more leisurely schedule with ample time for research and would prefer to continue in that way. They are aware, also, that if reduced research support both from University and outside sources continues, the institution cannot continue to sustain them indefinitely in nonteaching roles. The increased emphasis on teaching throughout higher education may make it difficult for faculty members in many fields to continue their traditional schedules of activity.

Faculty members generally agree that increases in enrollment, by whatever means, do not require proportionate increases in faculty or effort. Doubling enrollment may require faculty increases of up to two-thirds in basic sciences and considerably less for clinical instruction. Most of those interviewed were asked what methods they would prefer for accommodating additional students. Some rejected multiple admissions in favor of acceleration or new and increased facilities, but most favored dual admissions as the most satisfactory method of providing additional instruction, with the assumption that there would be increases in faculty as well. Given an enrollment of 200 per year, almost all faculty members would prefer carrying out instruction in two groups of 100 each, rather than the larger group, even though it meant an increase in teaching load. They feel that it would be impossible to establish the amount of personal contact and individual counseling that is necessary, especially for first year students, in the larger group. However, larger classes mean that faculty must give more attention to planning and preparation, which tends to improve instruction.

Reduced faculty time and double scheduling tend to make curriculum change more difficult and less likely to occur in the opinion of many faculty members, although this would be a much smaller problem in basic science if only medical students were involved. Planning, scheduling, and preparing new courses is very time consuming, and heavy teaching loads inhibit the addition of this extra burden. In addition, faculty members

need commitment to particular courses for best results. Under the dual system, a given course may be taught by different people at each half-yearly repetition. This is particularly significant for newly developed courses. However, under the dual system, instruction is more of a continuing ongoing program, which tends to increase quality.

The faculty salary supplement provided as a result of increased teaching loads resulting from semiannual admissions and acceleration was, of course, most welcome, especially in the period before faculty salaries were given a general boost.

Many faculty members are concerned about differences in the quality of the two yearly classes, although the basis for their concern is not entirely clear. In any case, as mentioned previously, this quality difference is not a necessary concomitant of semiannual admissions, but results from other features of the admissions policy.

Some department heads felt that semiannual admissions added to their administrative burdens, but agreed that this may be more a function of the number of students than of their temporal distribution. On the positive side, of course, semiannual admissions tend to spread the administrative load out over a larger portion of the year, which is desirable.

UTCM faculty members do in fact receive substantial research support from a variety of sources, and the volume of research output does not appear to be seriously lower than that at most other medical schools. One problem that did exist and still does to some extent, in the view of many UTCM faculty and administrators, is that grantors of research funds have often believed, whether erroneously or not, that UTCM faculty members do not have adequate time to conduct good research, and may have refused grants on those grounds. It is difficult to assess the effect of this attitude on actual receipt of research funds, but certainly many faculty members believe the effect has been more than minimal.

Many instructors whose subjects require the extensive use of laboratory facilities feel that the laboratories function better because they are used more continuously. Technicians can be employed on a full-time year-around basis, and this helps to keep laboratory facilities up to necessary standards at all times. It also reduces the start-up time for each entering class, so that effective laboratory instruction can begin almost immediately.

Some faculty members feel that there is not enough time for electives and student research. This relates more to acceleration than to dual admissions, however, and many would favor the semiannual system more

strongly if it were run on a normal four year schedule, thus providing additional time for research and electives. This, of course, conflicts with the expressed desire of most students to continue with the accelerated schedule. Practitioners do require some research training, however, to free them from too heavy reliance on the printed word, and give them some ability to evaluate research findings. Some feel that there may be too much emphasis on electives, and that all general practitioners, at least, should have a common base.

A common complaint among faculty members is that there is not enough time in the total curriculum at UTCM for all the instruction that needs to be given, and that both double scheduling and acceleration reduce flexibility. Increases in faculty would help to compensate for these lacks, but could not solve the problems entirely since they are largely a function of lack of student time. Students get little clinical laboratory experience. They tend to lack depth in certain areas, because they do not have time to read and study, and there are some limitations on study facilities. The system does, however, foster responsibility for those who can accommodate to the fast pace. As previously mentioned, December graduates are encouraged to stay on for research or preceptorships to give them more time and greater depth, although there is little money to support them for this period. The lack of flexibility is reflected in the fact, for example, that only half of the clinical pediatrics students have been through the clinical medicine instruction before their entry to pediatrics. The pediatric staff would prefer that all of them had had those experiences previously, although they point out that UTCM students do very well on pediatric board examinations.

Some faculty members have serious misgivings about the problem of December graduates being out of phase with the intern matching program. They feel that the better internships and residencies are available in July, and that too many December graduates stay in Memphis for internships, because they are available in mid-year. They tend, therefore, to be inbred and do not get the breadth of experience that is desirable in preparing for their later careers.

Organization, Management, and College Operations

Much of the material concerned with organization, management, and college operations has been presented in previous sections, and the financial analysis will appear in the next section. However, certain attitude, opinion, and other factors can appropriately be discussed here.

The basic organizational problem at UTCM is that of the existence of separate basic science and medical schools, and the fact that a variety of students other than medical students use the College of Basic Medical Sciences. This problem has received comment in the last two accreditation reports, and it was discussed by many of those interviewed during the study. The separation is related to the semiannual admissions system, since it tends to make even more difficult the process of organizing curriculum and faculty to meet the educational needs of the large UTCM Medical classes entering twice a year. Close alignment of basic science and clinical programs and the development of appropriate content and scheduling of basic science courses for medical students have required the closest cooperation among the various school administrators, and the degree of success that has been attained is a credit to the effectiveness of that interaction. At best, however, the arrangement is unsatisfactory in the opinion of most of those concerned with school operations. In particular, the separation of the Department of Pathology from the Medical College is regarded as undesirable. The trend in medical education is toward starting clinical instruction earlier, which is difficult in the UTCM organizational structure. Both faculty and administration might be used more efficiently if the schools were combined.

Curriculum change, particularly with respect to scheduling, is difficult at best at UTCM because of the large classes, accelerated schedule, and dual admissions. The separation of basic sciences and service to other kinds of students has compounded this difficulty. The functions of the medical school under a dual admissions system could be much more effectively carried out if the relevant departments now a part of the College of Basic Medical Sciences were administered by the Dean of the College of Medicine.

The physical separation of various basic science and clinical departments has also complicated the problem of operating the dual admissions system with two large classes. This is primarily a facilities problem rather than an organizational one, but the system would operate better in integrated facilities that were closer together. Some of the admission system benefits of more efficient utilization of laboratory and other facilities tend to be lost because of the location of physical facilities over a fairly large area.

In many institutions under an annual admissions system some laboratory and other facilities are idle for a good portion of the year. Multiple scheduling obviates this problem at UTCM, but fuller utilization would exist there even under an annual system because of the many students from the nursing, dentistry, and pharmacy schools that use those facilities. The same is true with regard to full faculty utilization in

basic science. Basic science departments cannot be justified on the basis of part time teaching operations, as tends to be the case with annual admissions.

As has been previously mentioned, acceleration and double scheduling have made it difficult for students to conduct any research on their own. In any case many administrators feel that research training in basic science is not essential to the conduct of undergraduate medical education. Some feel that it has limited value in pediatrics, somewhat more in pathology, and that it is to some degree essential in medicine and surgery. The UTCM system is not, in their view, as effective as it might be because of the limited opportunities for student research in the latter fields. Most agree that faculty research is important in creating a good learning environment, and feel the amount of such research as UTCM is adequate even with the heavier teaching loads necessitated by the semiannual admissions system. In medical education generally there is a lessened emphasis on research and an increased attention to community medicine, family care, and clinical practice. The UTCM system with its lessened stress on student research in particular fits this new framework to a degree, but the College has not yet developed its curriculum, possibly because of previously mentioned difficulties in making curricular change, in the direction of providing much added instruction appropriate to community and family medicine.

The dual admissions system increases the administrative load but tends to spread it over a greater portion of the year. Greater dispersion is regarded as generally advantageous by most administrative personnel. Continuity of both instructional and research programs, without large peaks and valleys results from the dual system, and is felt to be desirable by many medical educators. Under an annual system, instructors may teach almost all day over a period of several months and then do research constantly for the remainder of the time. The semiannual system spreads both research and instruction over a greater part of the year, providing greater variety of activity at most times for faculty members and reducing boredom that might result from more repetitious activities.

There is obviously a close relationship between class size and the desirability and effectiveness of multiple admissions systems. As has been pointed out, at UTCM it would be impossible to continue the acceptance of a total of 200 students per year without the semiannual system, because of limitations on the size of individual classroom and laboratory facilities and on the total amount of facilities available. It would also be impossible to maintain the amount of student faculty contact that is thought to be desirable in single classes of 200. The larger the class, the greater is the reliance on objective examinations and the

elimination of essay tests, which is also seen as a disadvantage by many. It may be that the semiannual system is desirable only if enrollment is more than 150 per year, but since the trend is toward increased enrollments it is the best alternative available.

The role of basic science instruction in medical curricula and the ammount of time to be devoted to it are highly relevant to the question of the use of some form of multiple admissions. The trend is toward reduction in basic science hours and particularly in the time devoted to laboratory activities. Such reduction may make possible the use of multidisciplinary laboratories instead of separate departmental laboratories. However, if classes are too large, it may not be possible to make effective use of multipurpose facilities. Thus the small classes made possible by dual admissions may in turn provide the opportunity to develop and use more efficient crossdisciplinary facilities. Pharmacology and biochemistry now use the same laboratories in some schools, but they might not be able to do so with large classes entering on an annual basis.

It is felt by some administrators that with the substantial increase in UTCM faculty size that has occurred in recent years, there are now a good many faculty members who teach an embarrassingly small amount of the time, spending a disproportionate amount of time on research.

The semiannual system is regarded as desirable because it permits dropping back for less than a year for those students who cannot keep up or who are simply tired. It is easier to salvage students under the system, and this is highly desirable since it is total output that is of concern. Related to this is the fact that division into two classes of 100 permits the administration and faculty to detect academic or other difficulties early enough so that corrective action can be taken in a timely fashion. This would not be possible with a single class of 200. The large repeat rate does increase the administrative and counseling loads, but such activities made possible by dual admissions also save some students who might be lost to medicine altogether. The overall effect has been that, even with a relatively low quality input, the total attrition rate at UTCM is not markedly higher than the national average.

The increase in faculty required by dual admissions has meant that the ratio of senior to junior professors has changed in the direction of having more young, junior teachers. Several administrators commented on this, but did not specify whether or not they thought it was disadvantageous.

V COSTS PER M.D. GRADUATE

Costs can be viewed from two perspectives. On the one hand there are the dollar costs determined from accounting relationships. Economic costs, on the other hand, are based on forgone alternatives. If available resources are used to produce M.D.s, those resources cannot then be used in any other way. The alternative use to which those resources could have been put is a measure of the economic cost. When efficiency in the allocation of resources is the relevant consideration it is important to attempt to determine economic costs. Clearly there is a scarcity in the resources available for medical education, so that consideration of efficient allocation should be of importance.

However, determination of economic costs, based on the opportunities forgone, is at best extremely difficult to obtain. Most of our information on costs is derived from accounting procedures. Usually budgeted expenditure data provide the available cost information with regard to programs. This was the case at LSU and UTCM. Although accounting costs do not necessarily reflect economic costs, the actual data on expenditures show how the income received is spent. This form of cash flow allocation is useful not only to administration of programs but also to agencies which are the sources of funds. Although our concern was not with how medical education cost is financed, it is very probable that the method of financing does affect the flow of funds; and the flow of funds does affect the size of the relevant accounts from which our data were taken. By looking at cash flow we do, to some extent, reflect the method of financing in the cost calculations. Where a particular medical school receives its funds is a relevant consideration to the extent that characteristics of the school, other than some objective consideration such as the number of full time students, affect allocation of funds to the school.

Aside from the type of cost data available for this analysis, there are three problems that must be discussed. First, how do we handle research expenditures? This is an especially relevant problem for sponsored research, which is listed as a separate account and can be handled in any way that it is felt to be appropriate. Departmental research, on the other hand, is almost impossible to isolate in the departmental budgets. Our second problem reflects the division of the undergraduate M.D. program into the basic and clinical sciences. Although there has been

some change in curriculum toward integration of these two halves of the M.D. program, for the period of our review the division was clear. The problem is whether the entire undergraduate M.D. program should be included in the cost estimates or only some portion of that program. The third problem is whether some additional income should be taken into account because the students receive their M.D.s in less than the national average length of time.

Problem of Research Expenditures

The first problem concerning research costs is both the most difficult to resolve conceptually and the easiest to handle empirically. The issue is: what does it cost to produce an M.D. at UTCM and at LSU? For that purpose facilities, equipment, instructional and other personnel, along with other elements, are needed. Now the question arises, what amount of research is needed by a medical educator in order to carry out his duties as an educator? Some research is obviously necessary for adequate teaching in a medical school. But how much? It is also true that some of the research expenditures are necessary in order to attract desired faculty. But how much?

There appear to be three major bases for research activity: (a) research needed by young faculty members to establish their academic base, (b) research by faculty members to keep abreast of developments and therefore maintain or improve teaching ability, and (c) research prompted by the love of discovery. The second element is what we are mainly concerned with, but these three reasons are not independent in terms of their effect on teaching. Consequently, it is impossible to isolate the part of research expenditure "necessary" for adequate teaching. It is highly unlikely that all, or even a major share, of research expenditures are actually necessary to the teaching function. But we are in no position to say what percentage of sponsored or departmental research is a necessary component of medical education. However, the bulk of research expenditures will be listed separately, so we have been able to calculate the costs with and without these expenditures. Those who want to use all, none, or some proportion of those research expenditures in calculating cost per student can easily do so.

Problem of the Division of the Medical Program into Basic and Clinical Sciences

Our second problem concerning the extent of coverage in costing the undergraduate M.D. program, is really prompted by the difficulty of

determining clinical costs. In the clinical departments the actual accounting costs are usually a relatively small part of the actual resource expenditures. Clinical appointments with very little monetary remuneration are common; moreover, the mix of teaching responsibility to undergraduate M.D.s, interns, and residents, as well as the fact that the very learning process in the clinical area provides services to patients, all tend to confuse the allocation of costs.

For the clinical half of the medical curriculum, the problem is easier conceptually but far more difficult empirically than that for research. Ideally, all elements of the undergraduate program should be included in estimating the cost of producing M.D.s. That estimate is considered to be made when aggregate expenditures data are used (as we will do later), but many elements of economic cost are not included in that estimate, especially on the clinical side. One important cost is the "replacement value" of clinical appointees. This could to some extent be handled by imputing a value to the time spent in rendering the service. However, the major problem is that it is not clear whether such service should be considered a cost of education. Patient care is an output as far as the hospital is concerned, even though it is considered an input to medical education. Since most of the patient care would be rendered even if there were no undergraduate M.D. students using the clinical facilities as part of their educational program, it is very difficult to determine the incremental cost that should be apportioned to education, and it is the incremental cost that is relevant. What this means is that on the clinical side patient care is analogous to a joint product. The costs involved could of course be allocated to education and non-educational medical services by appropriate assumptions, but the data analyzed are not adequate to support additional assumptions for determining clinical costs. A major undertaking would be necessary to get the estimates that could be considered reliable.

In the clinical side of medical education, we make the assumption that there are little, if any, scale effects. This means that unit costs in the clinical departments will probably not change very much whether there is a semiannual or an annual admissions policy; whereas in the basic sciences, scale effects appear to be important elements of unit costs. The presence of scale effects is essentially an empirical question. Here again, however, empirical verification would be very costly. In the absence of needed statistical data we have used impressionistic evidence obtained through interviews at UTCM, and other medical schools. Most of the clinical faculty that we interviewed said that an increase in student enrollment would imply a proportionate increase in clinical staff. Since the capital and equipment component of costs are infinitesimal for small additions in undergraduate M.D. enrollment, it seems plausible that there are little, if any, economies of scale on the

clinical side from the undergraduate M.D. education. (However, there was one interviewee who did not agree; his feeling was that there would be a significant difference in unit costs for different class sizes.) Since we are concerned with the costs per unit of undergraduate M.D. training under alternative admissions policies, the absence of scale effects would mean that unit costs were not sensitive to the type of admissions policy in force. In that case, clinical science costs would not be a relevant consideration in evaluating the cost of the semiannual admissions policy at UTCM relative to that at LSU. For these reasons the costs that are relevant to evaluating alternative admissions policies need not include most of the clinical science areas. A crucial assumption, of course, is that the physical facilities needed are available. For example, at LSU in New Orleans, there is a shortage of available teaching beds in the local hospitals. Both Tulane and LSU use Charity Hospital as their main clinical education facility. Other things remaining the same, it seems clear that a significant increase in the number of medical students at LSU could lead to much higher costs because of the absence of available teaching hospital beds. We must assume, therefore, that there are adequate clinical facilities available.

There is a general principle that has guided our thinking in this discussion. The principle is concerned with the uses of cost estimates: a planning and a funding use. Planning estimates can omit entire areas of cost that would have to be included in estimates for funding. The objective of a planning estimate is the selection among alternatives; for that some major and minor areas of cost could be identical for each of the alternatives. In that case, those costs would have neutral impact on the decision. They can for purposes of intra-system comparison be omitted. With that omission the cost estimates could still be used for planning purposes, if not for funding.

It is important to emphasize the role of cost analysis as used here. In this study we are concerned with the estimation of unit costs under alternative systems of producing M.D.s. The alternatives chosen are the annual versus the semiannual admissions standards. The problem is the estimation of the cost of producing M.D.s under those alternatives. Consequently, only those costs that are affected by the admissions standard in effect are relevant to an analysis of these alternatives. Assuming constant returns to scale in the clinical half of the medical curriculum we can, therefore, ignore that component of costs. That, however, is not the reason why clinical costs have not been estimated; rather, it is the rationale that may justify their exclusion. The reasons for relying mainly on the basic science costs for this analysis are the extreme difficulty of obtaining reliable estimates of clinical costs and the time that would have been required to do so.

Problem of Additional Lifetime Earnings

The third problem is concerned with whether forgone earnings should be included (or if the earnings of an additional six months of lifetime earnings should be included). The problem arises because in general a UTCM student receives his M.D. in 39 calendar months, whereas the LSU student finishes his undergraduate medical education in 45 calendar months. Should the six-month differential in completion time be included as a cost (negative cost) of graduating sooner? A "yes" answer implies that there is a systematic difference between the lifetime stream of earnings with and without an additional six months. And that difference would be attributable to the extra six months of occupational life that would be available to someone obtaining the M.D. in 39 rather than 45 months. Initially, we had decided to estimate the discounted sum of an average one-half year of a physician's income, and add that sum to the costs of a student requiring the additional six months of schooling, i.e., the LSU student. However, during our discussion at UTCM we got the impression that the element of forgone earnings might not be relevant, or, if relevant, not very significant. In the first place, many of those who graduate in December serve 18 rather than 12 months of internship. Moreover, some wait six months to enter the March class. For them we would not add an extra six months of income to their estimated lifetime earnings stream. For our purposes it has been decided to exclude forgone earnings from the cost calculations, while bearing in mind the fact that accelerated programs, everything else remaining the same, will provide additional medical services to society.

Taking all of the above into consideration, our determination of the relative cost of producing an M.D. under an annual versus a semiannual admissions policy is based on the first half of the undergraduate M.D. program. Although that is primarily concerned with the basic sciences, there will be some elements of clinical science educational costs included. Those clinical science inputs provided outside the teaching hospital will be included in the costs of undergraduate M.D. training. This will consist mainly of lectures given and associated laboratory work done within the medical school per se. The costs given are the actual expenditures incurred for the several major elements of the educational program. An examination and explanation of the data used and the allocation methods adopted are given below.

Estimation of Costs

For the actual estimates of cost for the first half of the undergraduate M.D. program at UTCM and LSU we used the period from September 1965 to September 1967. We chose that period in the hope that it would

be possible to tie together information on graduates with relevant cost data. Since incoming students from the period selected would have finished their internship, assuming normal progression, by July 1970, information on those graduates could be related to the relative cost of their medical education. Costs per student were derived in two ways: (1) using aggregate data and (2) using detailed departmental budgets, estimates of effort, and assumptions with regard to estimated allocation of expenditures.

Aggregate Data

The first approach is relatively straightforward and it is the one usually employed in determining cost per student. Table 10 summarizes the data collected in this way. The costs per undergraduate M.D. student at UTCM and LSU are shown for the years 1965/66, 1966/67, 1967/68, and 1968/69. These costs include several divisions of expenditures, from general current fund expenditures only to all funds expended on associated medical school programs, including the estimated yearly depreciation charge. The table also shows the average of these costs over the four-year period, as well as the ratio of the same costs for LSU and UTCM.* There are several conclusions that seem worth highlighting.

- Over the four-year period used in Table 10 the rate of change in costs per student was generally higher at UTCM than at LSU. This is most evident when the "official" JAMA estimate of student enrollment is used as the denominator. However, the big difference in changing costs per student was for organized research, and not for general funds expenditures.

- Somewhat related to the above is the apparent importance of organized research and other restricted funds expenditures in aggregate costs per student.

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* One problem results from the position of the College of Basic Services as a service unit administratively independent of the College of Medicine at the University of Tennessee. In some instances 63 percent of the basic sciences expenditures was allotted to the College of Medicine, based on an estimate of the teaching load of the basic sciences due to medical students; in other cases 50 percent was allotted to the College of Medicine on the basis that that represented the ratio of College of Medicine students to total medical unit students at the University of Tennessee.

Table 10

AGGREGATE ANNUAL AVERAGE COST PER UNDERGRADUATE M.D. STUDENT AT LSU AND UTCM
1965/66 to 1968/69

	(1) 1965/66	(2) 1966/67	(3) 1967/68	(4) 1968/69	(5) Average Cost per Undergraduate M.D. 1965/66 to 1968/69*	(6) Adjusted Costs†	(7) Ratio of LSU/UTCM Ratio	Col. 5 Data	Col. 6 Data
Louisiana State University‡									
(A_1) General funds (current expense)	$ 6,452	$ 8,194	$ 7,526	$ 7,752	$ 7,481				
(A_2) A_1 plus organized research	10,850	12,006	11,848	12,950	11,914				
(A_3) A_1 plus all restricted funds	12,938	13,780	15,733	17,160	14,903				
(A_4) A_3 plus estimated yearly depreciation charge	13,247	14,088	16,043	17,471	15,212				
University of Tennessee									
JAMA estimate of students§									
(B_1) General funds (current expense)	5,020	5,599	5,958	6,173	5,688	$4,653	A_{1/B_1}	1.32	1.61
(B_2) B_1 plus organized research■	7,576	9,084	9,291	9,921	8,968	7,336	A_{2/B_2}	1.33	1.62
(B_3) B_1 plus organized research•	8,650	9,987	10,253	10,959	9,962	8,149	A_{2/B_3}	1.20	1.46
(B_4) B_1 plus all restricted funds**	8,921	10,684	11,399	12,242	10,812	8,844	A_{3/B_4}	1.38	1.68
(B_5) B_1 plus all restricted funds††	9,994	11,586	12,362	13,280	11,806	9,657	A_{3/B_5}	1.26	1.54
(B_6) B_5 plus estimated yearly depreciation charge	10,206	11,802	12,571	13,478	12,014	9,827	A_{4/B_6}	1.27	1.55
SRI estimate of students‡‡									
(C_1) General funds (current expense)	4,744	5,057	5,350	5,515	5,166		A_{1/C_1}	1.45	
(C_2) C_1 plus organized research■	7,160	8,205	8,342	8,864	8,143		A_{2/C_2}	1.46	
(C_3) C_1 plus organized research•	8,174	9,021	9,207	9,792	9,048		A_{2/C_3}	1.32	
(C_4) C_1 plus all restricted funds**	8,431	9,650	10,236	10,938	9,814		A_{3/C_4}	1.52	
(C_5) C_1 plus all restricted funds††	9,445	10,465	11,100	11,866	10,719		A_{3/C_5}	1.39	
(C_6) C_5 plus estimated yearly depreciation charge	9,645	10,661	11,288	12,042	10,909		A_{4/C_6}	1.39	

Note: For footnotes and source see the following page.

64

Table 10 Footnotes

* These four-year average costs are the simple arithmetic averages of the yearly figures shown in columns 1 - 4.

† The adjustment was made by multiplying the column 5 UTCM data that was based on the JAMA student population by the ratio of the number of weeks in the regular 1st year of study at LSU to the 1st two terms at UTCM, i.e., 36/44, or 0.818. This was done to make the calendar years comparable for cost analysis.

‡ The annual cost per student is found by dividing the total annual costs in the expenditure categories listed below by the total number of students as reported by LSU.

§ These ratios are based on the number of students reported in the Annual Education number of JAMA.

◘ Excludes Basic Medical Science organized research.

• All organized research including 63 percent of that for Basic Medical Science.

** Excluding Basic Medical Science organized research but including 63 percent of all other Basic Medical Science restricted funds.

†† All restricted funds, including 63 percent of all Basic Medical Science restricted funds.

‡‡ The number of students is based on all students enrolled in the Fall term of the year given plus one-half of those enrolled in the Spring term. This is done to obtain an enrollment figure for the "year" that is comparable for the two schools. Since the two terms at UTCM cover 44 calendar weeks, while classes for the academic year at LSU take up 36 weeks, we also used a denominator for UTCM that was adjusted by 36/44. That is, the total number of students at UTCM during the Fall and Spring term was multiplied by 0.818. The results were not very different from those found using the student enrollment described above. However, the student enrollment was higher using 36/44 as an adjustment factor; therefore, the annual costs would be uniformly lower. In general, the student enrollment was about 10 percent higher using the 36/44 ratio rather than using all the Fall students and one-half the Spring students.

Source: Financial Report for years ending June 30, 1966, 1967, 1968, and 1969 for LSU, and Report of the Treasurer for the years ending June 30, 1966, 1967, 1968, and 1969 for UTCM.

- The absolute level of costs per student was generally about 10 percent lower for the SRI estimated yearly student enrollment over that using the JAMA estimates for student enrollment at UTCM.

- Under any of the major classes in which expenditures were grouped, the costs per student at LSU were 20 percent or more higher than the costs at UTCM.

Departmental Budgets

The second way in which costs per student are derived is to use detailed departmental budgets and various estimates and assumptions, which are presented in Table 11.

Deflated Salaries. A factor, based on the relationship between average salaries for a given rank at the two medical colleges, was used to deflate the LSU salaries. The deflators are given in Table 12. It must be remembered that the average salary differential shown in Table 12 is derived from a very small sample of the total faculty (for instructional costs only).

Cost of First Half of Medical Training

The overriding concern in developing these estimates was to answer the following question: If we take an incoming class of undergraduate M.D. students and follow them through the first half, i.e., the basic sciences part, of their medical training program, what will be the resulting costs associated with that training? In other words, the estimates of cost should reflect expenditures made on incoming students over the first half of the undergraduate M.D. program. The period used was 1965-1967. We took two groups entering in September and March and called them one class. For UTCM, the class chosen consisted of the groups enrolled in Term I during the Fall 1965 and Spring 1966 periods. This was designated as the incoming class for which costs were estimated. The Fall 1965 group finished Term III (which at UTCM ends the basic sciences portion of the undergraduate program) by March 1967, and the Spring 1966 group finished Term III by September 1967. For LSU, the incoming class of September 1965 was used. It finished the two-year basic sciences portion of its medical education by June 1967. Those essentially are the two comparison classes for which unit costs are shown in Table 11. For UTCM the denominator of costs per student consisted of the actual enrollees in the courses for Terms I, II, and III.

Table 11

COST PER STUDENT DURING FIRST HALF OF UNDERGRADUATE M.D. PROGRAM*
1965/66 and 1966/67

	University of Tennessee		Louisiana State University†	
	Total	0.818 of Total‡	Total	Total Using Deflated Salaries§
Instructional costs**	$2,180	$1,784	$1,476	$1,366
Overhead costs††	3,321	2,717	4,039	4,039
Depreciation‡‡	324	265	533	533
	$5,825	$4,766	$6,048	$5,938

* The program as given in the respective catalogs for LSU and UTCM during 1965/66 and 1966/67. Some elements of cost are not included here, unlike the aggregate cost data presented in Table 10. Only those elements specifically enumerated here are included.

† An adjustment was made by imputing a salary to clinical appointments that was consistent with the average salary of a full-time faculty member of the relevant rank. The adjustment added about $20 per student for LSU. However, these imputed values were not included in the totals given. The concept of the value of time spent teaching by clinical appointees is a difficult one. On the one hand there is a "replacement cost" that should be estimated, since if the clinical appointee were not performing the service a paid faculty member would be needed to do it. On the other hand, there is a nonmonetary payment that the clinical appointee receives in terms of student help; the student at that stage is similar to a physician's assistant. In a more thorough cost analysis, and certainly where the overall undergraduate education was being considered, the issue would have to be faced directly.

‡ An adjustment was made by multiplying the UTCM data, using the JAMA student population, by the ratio of the number of weeks in the regular 1st year of study at LSU to the 1st two terms at UTCM, i.e., 36/44, or 0.818. This was done to make the calendar years comparable for cost analysis.

§ See text for considerations with regard to deflation.

** Instructional costs were derived by multiplying the percentage of a calendar year's paid time that a faculty member spent in one of

Table 11 (concluded)

the relevant courses by the total remuneration received during that calendar year. The courses chosen were from Terms I, II, and III at UTCM and years 1 and 2 at LSU. The percentage of effort devoted by a faculty member during the period used was estimated by either the faculty member or by the department head. These estimates are not too reliable. The written instruction given was that "the estimate of effort devoted to a specific course should be stated as a percentage of time that the given course represented of total paid time of a twelve-month period during which the course was given. In other words, what we need is the percentage of a year's paid time that was devoted by Professor X to the particular course listed for him."

†† Overhead costs were obtained from the treasurer's reports and include administration, library, physical plant, and biometric computer center expenses for UTCM; and general administration, general expenses, library, and physical plant expenses for LSU. The allocation of these overhead expenses to the first half of the undergraduate M.D. program was made using the ratio of hours in given courses to total undergraduates M.D. hours. That ratio was used to allocate overhead to individual courses. The overhead was then divided by the number of students in the course, and then all the costs per student for the different courses were summed.

‡‡ The annual depreciation charge was based on (a) the current construction cost replacement value, and (b) an assumed 50-year life for all structures. This annual charge was allocated to individual courses in the same way as overhead expenses. This method probably underestimates the amount of depreciation that should be charged the first half of the undergraduate M.D. program, since most of the work during that period is done in the medical school facilities, for which depreciation was determined. The depreciation of clinical facilities, i.e., nonuniversity hospital facilities, has not been included. Moreover, the allocation of depreciation to different courses may not be reliable since the ratio of course hours to total hours is not necessarily a good index of utilization of facilities. On the other hand, it is relevant in that the more hours devoted to a given course the more time that a facility is being used by that course. It is also worth noting that through depreciation charges, other elements of clinical costs are included. This happens because the clinical staff, for example in pathology, uses basic science facilities. Moreover, some clinical staff members have office and research space in the medical schools, per se.

Source: Departmental budgets, level of effort reports, and SRI estimates for allocation of overhead and depreciation.

Table 12

SALARY DIFFERENTIALS AND RATIOS BY RANK FOR
1965/66 and 1966/67

	Department Chairman	Professor	Associate Professor	Assistant Professor
Salary differentials (LSU - UTCM)*				
1965/66	+$ 542	+$ 382	+$1,225	-$1,081
1966/67	+2,712	+5,181	+814	+551
Ratio of average salaries† (LSU/ UTCM)‡				
1965/66	1.026	1.027	1.101	0.907
1966/67	1.120	1.306	1.056	1.043

Note: Instructors' salaries were not included because there were too few observations.

* UTCM salaries subtracted from LSU salaries.
† These were the deflators for LSU instructional staff salaries used in Table 11.
‡ LSU salaries divided by UTCM salaries.

Source: Departmental budgets.

The student enrollment for LSU, used as a denominator for the cost per student ratio, was 142 students in their first year (1965/66) and 132 in their second year (1966/67). For LSU we did not have available the actual number enrolled in each of the relevant courses during the period studied, so the official class enrollment for the incoming class of 1965/66 was used as an appropriate average for all relevant courses. The student enrollments used as denominators for UTCM and LSU were employed in order to get consistency for the costs deemed appropriate. The problem is to estimate costs per student in a way that allows us to determine the relative expenditures needed to provide a given level of medical education if one or the other admission policy were used at a school providing the given level of education. Some of the criticism of an early draft of the cost study was based on a misunderstanding of this central point. That point may be worth repeating in another way: the goal of determining unit costs is to estimate the relative expenditures needed to provide a given level of medical education to a specific group of undergraduate M.D. students. It would be of value to obtain these estimates for all the undergraduate M.D. students, and also to cover the entire curriculum at UTCM and LSU, but those tasks were not possible using departmental data, which consisted of detailed departmental expenditures with emphasis on staff salaries.

Table 11 was derived using the following formula as a general guide:

$$C(s) = \Sigma_h \Sigma_i \Sigma_j \left(\frac{C_{hij}}{N_{hij}} \right)$$

where

$C(s)$ is cost per student

h is budgetary item in dollars, e.g., instruction, administration, maintenance, equipment

i is school level, e.g., Terms I, II, or III at UTCM and Year 1 and 2 at LSU

j is program, e.g., anatomy, physiology, biochemistry

C_{hij} is total cost of budgetary item h, at level i, for program j

N_{hij} is number of students for budgetary item h, at level i, for program j.

One of the most difficult aspects of estimating cost using the above method was to determine reliably the proportion of, say, a faculty member's time for program j at level i, or to determine the appropriate capital charge for classroom space by programs and levels. We had to determine the appropriate allocation on an ad hoc basis as data were being collected. We started with a set of plausible constraints such as the following for instructional costs.

$$\text{Instructional costs per student for Term 1} = \left(\frac{\alpha_j I_j}{N_j}\right)_1 ,$$

where I_j is the instructional cost per year for faculty member giving course j in Term 1; α_j is the proportion of paid time spent by the instructor in course j during Term 1; and N_j is the number of students taking course j in Term 1. This would presumably give us the instructional costs per student for course j during Term 1. The allocation method for depreciation and overhead charges is explained in the footnotes to Table 11. A number of alternative allocation methods were considered and discarded. Among them were the percentage of time spent on the different programs, the percentage of use of a specific budgetary item for a given program, the relative square footage of floor space occupied for different programs, and the ratios of direct program costs to total direct costs. Some of these alternatives would be more appropriate for different classes of costs, for example, square footage of space used for allocating depreciation charges; but, in all cases the discarded methods were not feasible given the financial constraints.

In Table 11 it should be noted that departmental research expenditures are included in the instructional cost per student. However, the research component in instructional costs is probably very small. It is organized research and research from restricted funds that provide the bulk of research expenditures. The emphasis at UTCM is on teaching. Given a semiannual admissions policy, and current levels of faculty staffing, the emphasis at UTCM, particularly in the Basic Sciences, is on a year-round teaching obligation. The average amount of time devoted to supported research by faculty members appears to be far less at UTCM than at LSU. Consequently, if all expenditures on research were included in determining the cost per undergraduate M.D. student, the results would be biased in favor of UTCM. Conversely, if no research expenditures were included, the result would be biased in favor of LSU. Comparing the ratios in Table 10 with those in Table 13 offers some confirmation of this assertion. For all cost relationships given in Table 10, LSU costs per student were 20 percent or more greater than comparable costs

Table 13

RATIOS OF COST PER STUDENT

	Total LSU* / Total UTCM†	Total LSU / 0.818 of UTCM‡	Deflated LSU§ / Total UTCM	Deflated LSU§ / 0.818 of UTCM
Instructional costs only	0.68	0.83	0.63	0.77
Instructional and overhead costs	1.00	1.22	0.98	1.20
Instructional, overhead, and depreciation costs	1.04	1.27	1.02	1.25

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* Column 3 of Table 11.
† Column 1 of Table 11.
‡ Column 2 of Table 11.
§ Column 4 of Table 11.

Source: Table 11.

for UTCM, whereas Table 13 shows that LSU expended significantly less per student for instructional costs than did UTCM. Although the ratios in Tables 10 and 13 are not comparable,* there is an indication that the aggregate data may give misleading results if one is concerned with determining the actual resources expended on medical education per se. We do not think, however, that the data generated for Tables 10 and 11 (from which the ratios in Tables 10 and 13 are derived) are strong enough to support many such comparisons. But it does seem that only when costs other than those for instruction are included in the numerator will the costs per student be significantly higher at LSU. As LSU is our control for the annual admissions college of medicine, it seems that the semiannual standard shows a distinct cost advantage only when overhead and depreciation charges are included. This seems reasonable since it is the spending of fixed (and semifixed) costs that has been suggested as the prime reason for lower unit costs resulting from a large increase in student enrollment with a semiannual admissions policy.

Although the costs in Table 11 are for only one component of all undergraduate M.D. students at UTCM and LSU during a two-year period, and the costs in Table 10 are for all students during one year, it can be seen that the costs per student in the two tables are in the same range. The observation appears valid if we make two assumptions with regard to the data in Table 11. First, we assume that one-half of the total cost per student can be attributed to each of the two basic science years; and, second, that the incoming students, who are being used in the denominator, represent one-quarter of the total undergraduate M.D. enrollment. With these assumptions we find that the total costs per student of Table 11 are approximately what general-plus-all-restricted-funds expenditures per student were at LSU and UTCM during 1965/66 and 1966/67. Furthermore, the instructional costs per student of Table 11 are roughly consistent with the general funds expenditures per student at UTCM from Table 10 for 1965/66. Unfortunately, however, similar figures for LSU do not show any such agreement. Why this should be we have not been able to determine.

In estimating the annual average cost per student at UTCM, problems arise in both the numerator (costs) and the denominator (number of students). For the numerator our problem is in determining the components of Basic Medical Science costs that should be included in order to get a realistic comparison with LSU, given the goals of this cost analysis.

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* One important difference is that the costs in Table 11 are for a given group of students over the entire first half of their undergraduate M.D. training; whereas in Table 10 the costs are aggregates for the year for all students.

Whether the assumptions used in this chapter are the appropriate ones is probably less open to doubt than is the actual allocation percentages used. For the denominator, the problem, clearly, is in determining the relevant student population to be included in order to get the number of first-year students for a given fiscal year that can be made comparable to the base used for LSU.

Moreover, for both UTCM and LSU we have the problem of the reliability of the data used. In considering the importance of this problem, the purpose of the estimates must be remembered; that is, we have been concerned with comparing the average costs at UTCM with those at LSU. For the aggregated data we probably have fairly reliable indicators of the relative positions of those two schools, but the estimates of the absolute level of costs per student are open to more uncertainty. To reduce that uncertainty, we would need to have a more detailed examination of the appropriate inclusions and exclusions of various cost categories.

Finally, assuming the relative costs associated with turning out an M.D. at UTCM and at LSU hold for the entire population of medical schools, there is an important implication to be drawn from our cost analysis. The implication is that, other things remaining the same, if all schools were on a semiannual admissions basis about 20 to 30 percent more physicians could be produced with current medical school program expenditures. For example, given the 1969-70 expenditures on all regular operating programs in all medical schools, a semiannual admissions policy at the 87 approved medical schools could have enrolled from about 43,700 to 47,300 students, rather than the actual 36,536 during 1969-70; the larger enrollments could have meant about 10,050 to 10,870 new M.D.s rather than the actual 8,367 recorded in JAMA.[3]

An extended discussion of cost analysis is given in Appendix B.

VI CONCLUSIONS AND RECOMMENDATIONS

General

The basic general conclusion of the study is that the Tennessee dual admissions system is effective in meeting the expressed need for a larger number of physicians both in Tennessee and elsewhere. The system permits the graduation of substantially larger numbers of physicians than would be the case if the same facilities and staff were employed in the more conventional arrangement of a single class admission each year. It is generally agreed by those associated with administration and instruction at UTCM that the only alternative to semiannual admissions would be a reduction of almost half in total enrollment. For a variety of reasons enrollment decreases should not and cannot be made, so that in spite of strong faculty pressure to change to an annual system, there is a very low probability of such a change being made.

In section IV a list of positive and negative factors prepared by the UTCM faculty was presented. During the study evidence on most of these matters has been obtained, and specific conclusions will be applied to each item. Evidence for the favorable effect of almost all of the factors listed as potentially favorable was found in the study.

- Favorable items on the faculty list

  - Time, space, and equipment are more efficiently utilized under the semiannual system.

  - The M. D. degree is obtained in a shorter period of time in most cases, but this is a function of acceleration rather than the admissions system.

  - As a result of acceleration also, the student's total time in residence is reduced by 13.5 percent.

  - There is more flexibility in admissions, since students have the possibility of entering at two different times of the year and more students can be admitted than would be the case with an annual system.

- Curriculum flexibility is not enhanced, however, because of limited faculty time to plan changes and because the accelerated schedule leaves little time for electives or student research.

- The penalty for illness or failure is less, since students can drop back only six months rather than an entire year.

- It is not clear whether or not more moderate and low income students are attracted to medicine by the savings in time and cost at UTCM, although it is a reasonable assumption.

- The smaller classes made possible by semiannual admissions make a definite contribution to the enhancement of student-faculty contact and probably provide a greater opportunity to use some essay examinations in place of objective examinations.

• Unfavorable items on the faculty list

- The dual admissions schedule is out of phase with college graduation and with house staff training programs, but in practice, this does not appear to be an unduly serious problem, since there is no shortage of applicants for the March class and most of them have bachelor's degrees. December graduates who want early internships can get them, although there may be a disproportionate number of them in Memphis hospitals, which brings about a degree of inbredness. In any case, UTCM graduates get more than their share of good internships.

- There is no room for curriculum expansion on the accelerated schedule, but this is not a function of dual admissions.

- Failing students do not have summers to make up their failures, and this does contribute to a high degree of class irregularity.

- Faculty time to rework and upgrade courses is somewhat limited as a function both of the large number of students and of acceleration.

- Time that may be scheduled is limited, but this relates primarily to acceleration.

- The difference in capability of the two yearly classes could be reduced without altering the semiannual admissions policy through changes in other aspects of admissions policy. In any case, this does not seem to be a serious problem.

- It is necessary for some faculty members to give lectures twice a year instead of once, but this does not seem to be regarded as unduly onerous by most faculty members. Many would prefer to teach only once a year, but they also recognize the difficulties involved in teaching a single class of 200 in existing facilities.

- Most students do not appear to feel particularly overstressed by the year-around schedule, which is also a function of acceleration, and in fact prefer a system that allows them to complete their degree work sooner. Some faculty members would prefer a more leisurely pace, but few express strong feelings of stress.

- Elective and student research opportunities are somewhat limited at UTCM, but this again is primarily a result of acceleration, not dual admissions. In any case, students do not see this as a serious problem, and most faculty members also make little of it.

- There is some lack of flexibility with respect to such things as summer clerkships that is occasioned both by the large class size and the accelerated schedule.

Some of the difficulties that have been encountered in the operation of the UTCM system are clearly ascribable to causes other than that of semiannual admissions. Acceleration can be held responsible for a number of problems such as the lack of time for electives and student research and the time stress felt by some students and faculty. The administrative separation of the College of Basic Medical Sciences from the College of Medicine and the responsibility of the College of Basic Medical Science to instruct substantial numbers of nonmedical students have tended to compound problems relating to semiannual admissions and acceleration as well. The semiannual system might function more effectively if the medical and basic science colleges were under the same Dean, and basic science instruction was more specifically tailored to medical students needs. Curriculum change, for example, could be accomplished more readily under the latter circumstances. It has not been possible, during this study, to assess the precise effects of any one

of the administrative or organizational arrangements independently of the others, since the whole is a complex interacting system, but there is no substantial evidence that the dual admissions system as such is responsible for a disproportionate share of any problems encountered in the operation of UTCM.

Suggestions and Recommendations Regarding the Establishment of Multiple Admissions Systems in Medical Schools

UTCM has had a multiple admissions system since 1930. The change from four entering classes a year to two was made in 1964. The institution has, thus, had long experience in operating a unique program. Admissions and scheduling problems as well as stress on the faculty were reduced when the change to two classes per year was made. An institution planning for adopting multiple admissions for the first time would clearly have greater difficulties than are now being experienced by UTCM since there would be no appropriate background for operating such a system and less time to bring the system into effective functioning. Much of the experience of UTCM is, nevertheless, relevant to the planning and implementation of multiple admissions systems at other schools.

It seems probable that schools considering the adoption of a multiple admissions plan as a means of increasing enrollment might at the same time be considering other changes such as accelerated scheduling or curriculum content alterations. Comprehensive planning for all such changes and coordinated implementation appear to be superior to a piecemeal approach of making one change at a time, which would tend to keep school operations in a continuing stage of upheaval as each new change was introduced sequentially. If a variety of significant changes are to be made, however, planning before implementation--and the implementation itself--may occupy a period of several years and a substantial amount of faculty and administrator time. This will certainly be the case if new or changed facilities are required as well.

The key group to be considered in making any significant change in school function is the faculty. Unless most of the faculty can be convinced that the change is desirable from an educational point of view, and that it will not have serious adverse effects on their own careers and prerogatives, such a change cannot be successfully made. The experience of George Washington University is relevant, since the school has been concerned with planning for double scheduling and attendant construction of new facilities for several years with the program getting underway in 1972. The first step was to assure the faculty that individual teaching loads would not be increased and that new full time faculty

members would be hired to cover the increased instructional time. So long as faculty members are aware of the need to produce additional physicians to meet the health requirements of society and are given maximum opportunities to participate in the planning and implementation of new programs there should be no great difficulty in getting their full cooperation. If resources are sufficient to insure that teaching loads do not need to be increased greatly or that additional compensation will be provided commensurate with increased loads, there is no reason to expect strong faculty resistance to a change to multiple scheduling, since there is no evidence of any serious educational disadvantages in a well planned semiannual system.

Semiannual admissions require changes in the administration of admissions operations, records keeping, and student affairs. Increases in enrollment made possible by semiannual admissions will entail increased administrative work. That part concerned with admissions procedures will, however, be spread out over a greater portion of the year than is the case with a single admissions program, so that the usual short period of intensive activity may be avoided with proper planning. In view of the greater dispersion of activities, the personnel and associated costs may not have to be increased greatly to accommodate additional students. Scheduling the use of facilities and classrooms will be more complex and, therefore, somewhat more difficult. The additional effort required should not be great, but there may be a requirement for some additional help both in school central administrative offices and to assist department chairmen. As in the case of the faculty discussed above, it is essential that key administrative personnel be involved in the planning for a change to a semiannual system.

It is assumed that cost estimates both for the changeover process and for operations after the changeover would be prepared for the use of policy and decision making bodies outside the school as well as school administrators and faculty members.

Although the study detected no serious student dissatisfaction with the semiannual system at UTCM, it would be desirable for any medical school contemplating a change to a multiple admissions system to obtain the views of students on the subject and to take those views into account in planning and decision making. This might be done through interviews, brief questionnaires, or by setting up a student advisory group to meet on a periodic basis with planners.

A change to a semiannual system, especially if changes in curriculum and scheduling are also planned, will require a major planning effort on the part of any school undertaking it. Planning and decision making

procedures would not be different in kind from those routinely used by faculty and administrative committees for making any alterations in the functioning of medical schools that have been made in the past. For such major changes, however, planning must involve a larger proportion of the faculty and administrative staff than would normally be the case, and will require more thorough consideration of the effect of the changes on all interested parties. Substantial time and effort will be needed--both from those usually concerned with change, and from others who are rarely involved and then only in more routine matters.

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Appendix A

DUAL ADMISSIONS SYSTEMS FOR MEDICAL COLLEGES

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DUAL ADMISSIONS SYSTEMS FOR MEDICAL COLLEGES

1. What is your judgment of the overall quality of the UTC Program as compared to single admissions programs?

   Assume comparable student inputs.

2. How is this quality level related to the Dual Admissions System?

3. Indicate any organizational, administrative, or supervisory problems attributable to the Dual Admissions System.

4. Is the administrative load heavier?

5. Are facilities and equipment and faculty more efficiently used under the Dual Admissions than the Single Admissions System? Less? About the same? Why?

6. Would some of the problems of the Dual System be alleviated if it were maintained but total time was extended by 1, 2, or more terms?

7. How does Dual Admissions relate to de-emphasis on research, emphasis on community medicine, and clinical practice?

8. Are there inefficiencies in the distribution and utilization of faculty and student time associated with Dual Admissions as compared to Single Admissions?

9. Are there problems relating to other academic and hospital schedules under the Dual Admissions System?

   What are they?

   a. Placement in internships and residencies?

   b. Undergraduate schedules relating to admissions times?

10. Are fatigue and stress levels for students and faculty higher under the Dual Admissions System?

11. Is the general academic atmosphere satisfactory under the Dual System?

12. Is curricular revision more or less difficult under a Dual Admissions System?

13. How much curriculum and scheduling flexibility can be built into the Dual System? The Single System?

14. How easily can new material be added or course format changed?

15. How is the basic science curriculum and schedule affected by the Dual Admissions System?

16. How do basic science laboratory requirements relate to Dual Admissions?

17. What is the level of professional satisfaction of faculty under the Dual System? Under the Single System?

    Consider salaries, space, working conditions, and research opportunities, as well as the Dual System in giving answer.

18. How does the Dual Admissions System affect the recruitment of faculty members?

19. What are the reasons for faculty turnover under Dual System? Under Single?

20. Is the faculty teaching load too heavy under the Dual System? Break down answers by department.

21. Do clinical and science faculties differ in their preferences for one or the other admissions system?

22. How are student/faculty ratios affected by the Dual Admissions System? Are more faculty required? Answer by department how many more.

23. How are faculty age and experience and colleague relationships affected by Dual Admissions?

24. How does it relate to junior faculty responsibility?

25. How is competition for good out-of-state students related to Dual Admissions?

26. Is there sufficient opportunity for electives under the Dual Admissions System?

27. How does class cohesiveness and irregularity relate to Dual Admissions?

28. How does Dual Admissions relate to failure, repeat rates, and to salvageability of students?

29. How are student counseling requirements related to Dual Admissions?

    Awareness of first year student problems?

30. What special problems exist for December graduates under Dual Admissions?

    Internship schedules?

31. Does Dual Admissions affect good and poor students differentially? How?

32. How do you define a "good" internship or residency?

33. Do UTCM graduates obtain good internships and residencies in the same proportions as graduates of other schools?

34. Would medicine in general benefit if not all internships started at the same time?

35. What problems would result if internships began twice a year?

36. Are interns and residents from UTCM of higher, the same, or lower quality than the average of those from other institutions?

37. Does the Dual Admissions System affect proportions becoming G.P.s and other specialties? If so, how?

38. How much student-faculty contact is available and actually occurs in the Dual Admissions System? In the Single Admissions System? Relate to class size, class schedule, free time, overall schedule?

39. How does Dual System relate to teaching methods? Less lecture? More conference and bedside?

40. How much opportunity for student research is there under the Dual Admissions System? Under the Single Admissions System?

How much student research is actually done under Dual? Under Single?

Appendix B

CONCEPTUAL FRAMEWORK FOR COST ANALYSIS

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This appendix describes a conceptual framework from which we can operationally define relevant cost components. The utility of this framework is based on the fact that medical schools can be thought of as production units transforming given inputs (students, staff, equipment, and so forth) into outputs (physicians). The problem is to find the cost of those inputs specific to the output M.D. In general, a production function can be specified to show this relationship. One common form of such a function, used mainly by economists, is:

$$Q = A\, K^{\alpha}\, L^{1-\alpha} \qquad (1)$$

where Q is the particular output produced by the inputs of capital, K, and labor, L, through a transformation specified by the explicit functional form given. "A" is simply a shift parameter that allows the relationship to make shifts over time due to technological changes in the production process; α is the crucial parameter, for it shows the existence of scale effects. In the example given α is a positive fraction less than one, and $\alpha + (1-\alpha) \equiv 1$. This means that as you increase capital you get increases in output, but by some proportion less than the increase in K, which is the definition of decreasing returns to scale. Furthermore, since the sum of the exponents is identically equal to one, we are told that there are constant returns to scale by increasing K and L inputs by some given proportion determined by the estimated value of α. If we wrote the function as $Q = A\, K^{\alpha}\, L^{\beta}$, without specifying that $\alpha + \beta = 1$, we might find, through estimating the parameters using actual data from some production process, that there are increasing returns to K (i.e., $\alpha > 1$) or L (i.e., $\beta > 1$). This is valuable information because it tells us something about how inputs can be varied in order to achieve a given level of output. Now, if we know the cost of those inputs we can determine the least cost combination of inputs that would produce that output. On the other hand, the production function, given the inputs necessary to produce a specified output, can be used as a cost function once we get the price of inputs.

To continue, leaving aside fixed facilities and equipment costs (or inputs), we can think of a generalized function for the production of M.D.s as follows:

$$Q_{M.D.} = \alpha N^{\beta} ,$$

where $Q_{M.D.}$ is the output of M.D.s, N is the number of undergraduate medical students enrolled, and α and β are parameters of a staffing function. In this simplified form, output is dependent on the number of students enrolled and on all the staff inputs that transform them into M.D.s. The parameter, α, tells us the required number of staff members of a particular type that would be needed to produce $Q_{M.D.}$ and β tells us whether, given the manner in which the staff educates N, there are increasing ($\beta > 1$), decreasing ($\beta < 1$), or constant ($\beta = 1$) returns to scale. That is, if $\beta > 1$ it would mean that increasing the staff by some given proportion would lead to a greater proportionate increase in $Q_{M.D.}$. To bring this back to our discussion of cost functions, we can make the $Q_{M.D.}$ function more specific. Let

$$C_{M.D.} = (1 + p) \Sigma_i \Sigma_j a_{ij} N_j^{b_{ij}} V_{ij} \qquad (2)$$

where

$C_{M.D.}$ is cost of producing a given level of M.D.s

p is proportion of $C_{M.D.}$ attributable to nonstaff sources. Therefore, (1 + p) is the total contribution of staff and nonstaff sources.

a_{ij} is a staffing parameter showing the relationship of staff category i at educational level j per medical student.

N_j is number of medical students at educational level j.

b_{ij} is another staffing parameter for staff category i at level j. This one shows the rate of change of $C_{M.D.}$ with respect to number of students (essentially class size).

V_{ij} is average staff salary for the i^{th} staff category at the j^{th} educational level.

Equation (2) can be used to estimate current operating costs of undergraduate medical school education for the given staff categories and educational levels. The staff categories that seem most relevant would be the several types of instructional staff, administrative personnel, maintenance, and perhaps technical aides. The relevant levels would be for the first half of the undergraduate M.D. program. The usefulness of Eq. (2) would depend on having adequate data for reliable estimates of the two main parameters, α and β. For the particular data collected in this study there was not enough variance in N and V to obtain reliable estimates. (A variation of this model was used to estimate costs for large urban schools. See Richard J. O'Brien, "Cost Model for Large Urban Schools," Technical Note No. 30, National Center for Educational Statistics, U.S. Dept. of HEW, April 26, 1967.) However, even though this model was not used to estimate current operating (and other) costs, the structure of the model is useful in showing what elements of a cost function are important for our evaluation. For example, the term N^b can tell us the relationship between proportionate change in class size and in costs. Changing student/staff ratios, which would be reflected in N^b, are important considerations for evaluating an annual versus a semiannual admissions policy.

Even though for this project it did not provide us with an operationally useful cost model with which we could estimate undergraduate M.D. costs, this diversion shows us a conceptually sound basis for evaluating the costs of alternative systems. The data collected in this investigation of UTCM and LSU are not adequate for estimation of the parameters of that type of production function. It might, however, be possible to use the production function approach if all medical schools were included over a number of years. This would allow a fairly broad range of cross-sectional data to be generated, along with some time series. The combination of the two sets of data might provide the required inputs for deriving reliable statistical estimates. Although in this report we have not been able to use the production function directly, we have kept the general framework of relevant input-output relationships in mind when collecting available data. Moreover, it is the framework that is important, not the particular function specified.